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FUTURE MEETINGS: The American Society of Ichthyologists and Herpetologists will meet in San Diego and La Jolla, California, in June, 1959. The 1960 meeting will be held in Chicago, Illinois.

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Courtship and Spermatophore of *Plethodon jordani metcalfi*

JAMES A. ORGAN

ASIDE from one note on incomplete courtship (Green and Richmond, 1944), nothing has appeared in print concerning the courtship of any member of the *Plethodon jordani* group. The following information is based on five field observations and twelve observations on captive *Plethodon jordani metcalfi*. At no time were the specimens under observation treated with drugs or hormones. All observations were carried out on the north facing side of Whitetop mountain, Smyth County, Virginia, during the summer of 1957.

I am indebted to Nelson G. Hairston of the University of Michigan Department of Zoology and Charles F. Walker of the University of Michigan Museum of Zoology for reading the manuscript and to my wife for her assistance in the field.

## COURTSHIP

In general, the courtship of *P. j. metcalfi* follows the pattern described by Noble and Brady (1930) for plethodontid salamanders. Furthermore, the pattern observed in the field was found to correspond rather closely to that displayed by captive specimens. A generalized courtship pattern for *P. j. metcalfi* appears in Figures 1 and 2. These figures represent the more usual positions assumed during courtship and were drawn from numerous field sketches. The figures do not, however, include the many variations as observed in the details of courtship.

The male usually approaches the female and executes a series of nosing movements using his snout and nasolabial grooves. The male then places his mental gland and nasolabial grooves in contact with the side, back, or more often the tail of the female and executes a "foot dance" in which the limbs are raised and lowered (Figs. 1a and 1b). After contact is established between the chin of the male and the integument of the female, the male slowly moves towards the female's head (Fig. 1c). While moving forward along her body, the male occasionally raises his head slowly. As the adhesion between his mental gland and her skin breaks, the male's head snaps upward. He then lowers his head and reestablishes contact with the skin of the

female. Having reached the head of the female, the male proceeds to press his mental gland and nasolabial grooves between her eyes and over her nasolabial grooves (Figs. 1d and 1e). The male next circles under the female's chin and laterally undulates his tail as it passes beneath her chin (Fig. 1f). The female places her chin on his tail and moves forward to its base with her limbs astride his tail (Fig. 2g). The two then engage in a tail-walk during which the female maintains her position at the base of the male's tail (Fig. 2h). Should the female slip back towards the tip of his tail, the male stops moving forward but continues to undulate his tail while she regains her position. The male finally stops moving forward and begins a series of lateral sacral rocking motions. The female, which has been relatively passive to this point, now begins a series of lateral head movements in synchronization with but counter to the lateral sacral movements of the male (Figs. 2i and 2j). This latter behavior is identical to that described by Stebbins (1949) for *Ensatina eschscholtzii*. The male then presses his vent to the substratum and deposits a spermatophore. Immediately after deposition, he arches the base of his tail upward slightly (Fig. 2k) and both he and the female move forward and stop when the vent of the female is over the spermatophore (Fig. 2l). The female lowers her sacral region and picks up the sperm cap with her cloacal lips. The entire jelly stalk of the spermatophore is left adhering to the substratum. The pair may continue to court for a few minutes and then separate.

The physical conditions under which courtship occurred in the field are given in Table I. Time is expressed throughout this paper as eastern standard time.

Much of the variation observed in the courtship of *P. j. metcalfi* was due to differences in the position assumed by the male during courtship and spermatophore deposition. On August 3, a courting pair was observed on top of a spruce branch which was lying on the forest floor. Just prior to deposition of the spermatophore, the male bent his tail sharply to the left and curved it downward along the curvature of the branch.

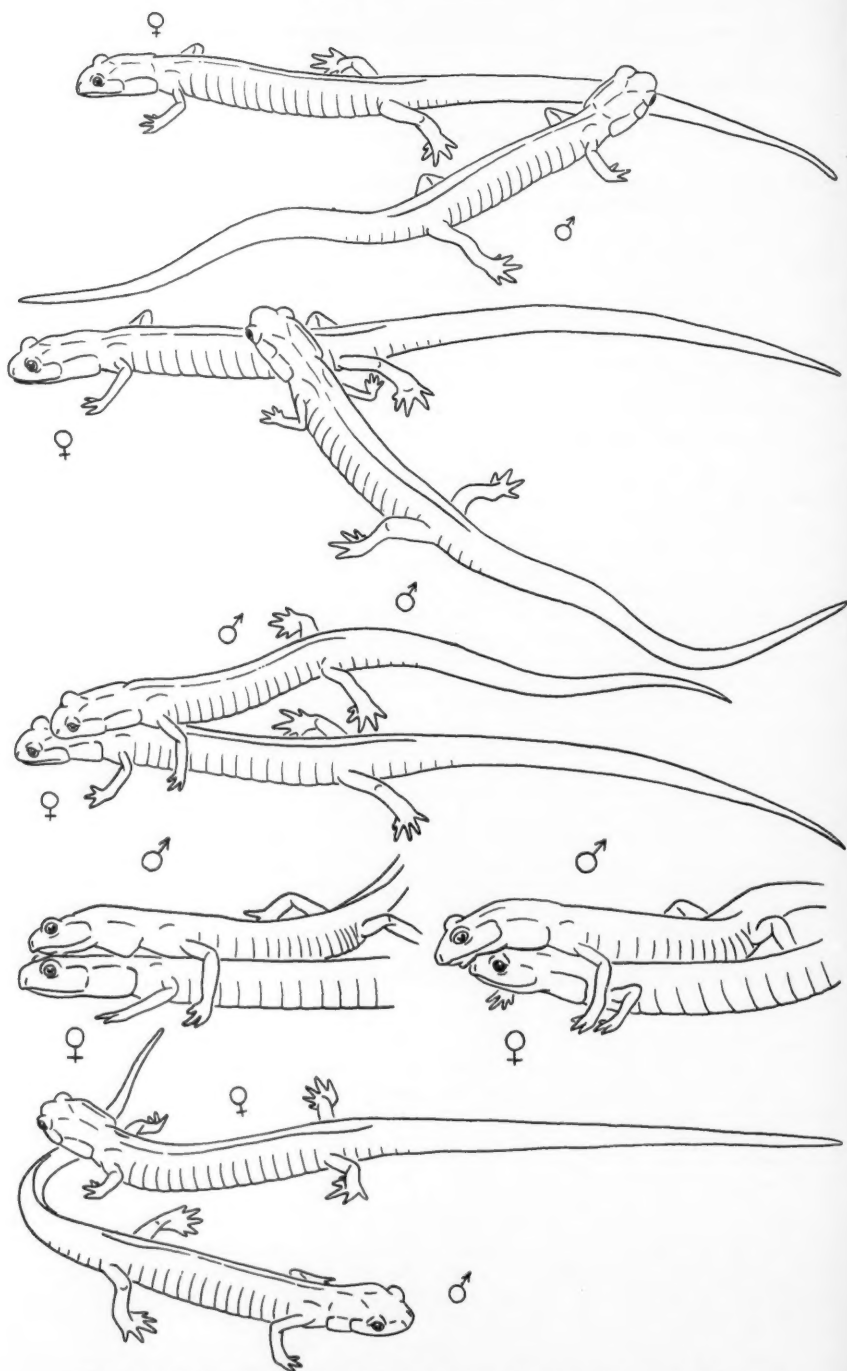


Fig. 1. A typical sequence of the steps in the courtship of *Plethodon jordani metcalfi*.



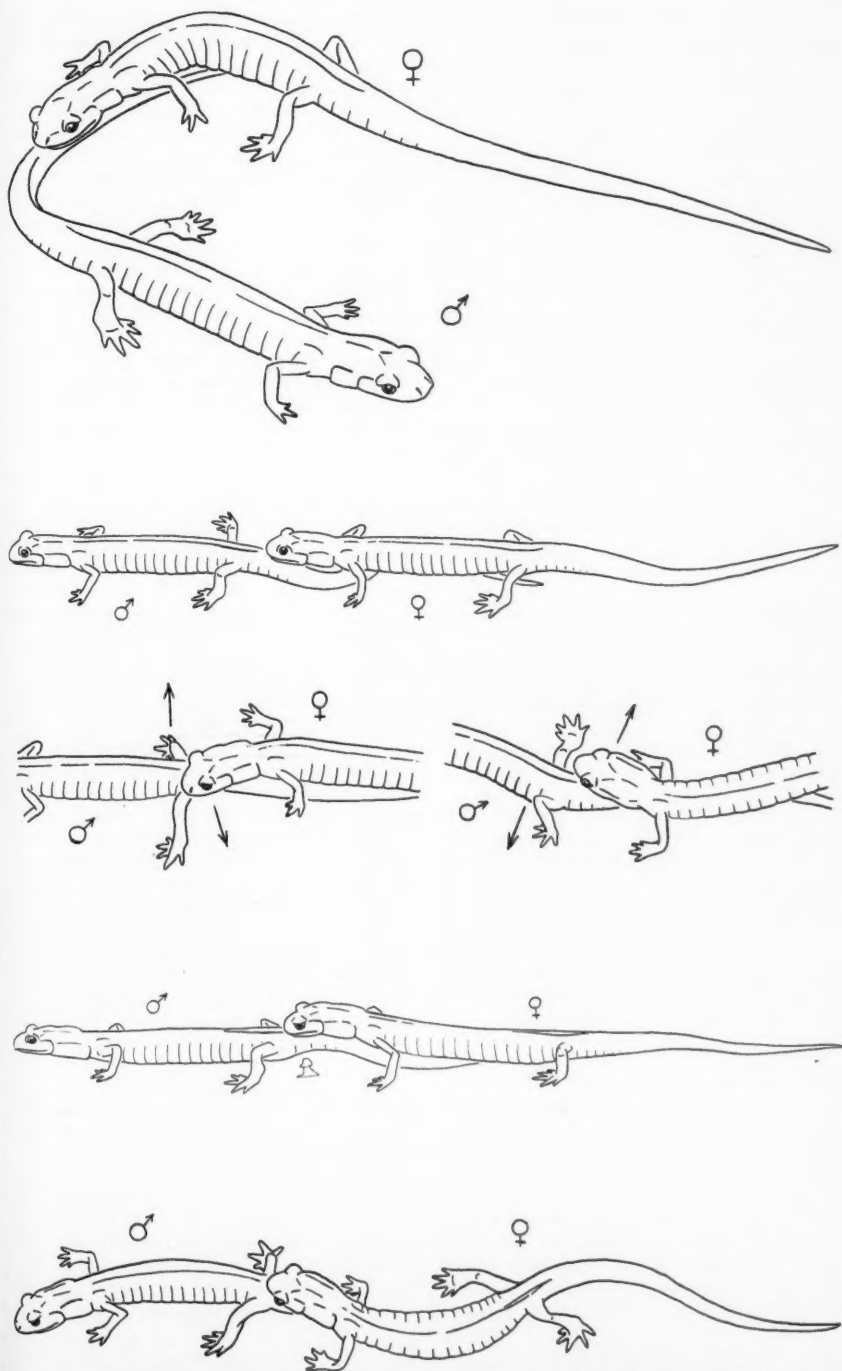


Fig. 2. A typical sequence of the steps in the courtship of *Plethodon jordani metcalfi*.

In five other instances in which spermatophores were observed being deposited, the body and tail of the male remained oriented along a straight axis except for pelvic rocking motions and strong lateral tail undulations.

On August 15, a courting pair was seen on moss on the forest floor. The body of the male was sharply bent to the left in the form of a reversed "C" with his snout almost in contact with that of the female who had her chin pressed against the base of his tail. The male was executing pelvic rocking motions and the female was moving her head laterally in a direction counter to his pelvic movements. The more typical position at this stage of courtship is with the body and tail of both the male and female oriented along a longitudinal axis.

On August 5, 9, 11, 12, and 13, incomplete courtships were observed on captive speci-

limbs. On the evening of August 4, these movements were timed in a captive male. All four limbs were moving alternately and the timing was based on the movements of the left hind limb. This limb was raised and lowered as follows: 5 times in 22 seconds, 5 times in 17 seconds, and 17 times in 32 seconds. There was apparently no regular rhythm. The behavior can best be described as that of an animal trying to slowly free itself from a very sticky surface.

The lateral pelvic rocking and tail undulations of the male, however, do seem to have a definite rhythm. On August 5 these movements were timed in a captive male and were found to average one wave every 2.2 seconds. The frequency of these undulations did not vary but the amplitude of the undulations increased just prior to spermatophore deposition.

TABLE I  
PHYSICAL CONDITIONS UNDER WHICH COURTSHIP OCCURRED IN THE FIELD

All observations were carried out on the north facing side of Whitetop mountain, Virginia, 1957.

Date	Eastern Standard Time	Altitude in Feet	Temperature in °C		Relative Humidity		Light on Forest Floor
			Ground	Air	Ground	Air	
Aug. 3	11:40 PM	5425	16.6	17.0	—	94%	Total Darkness
Aug. 15	9:25 PM	5300	16.2	16.0	100%	97%	Total Darkness
Aug. 19	7:45 PM	3900	15.4	14.8	97%	89%	After Dusk
Aug. 27	10:30 AM	3800	—	—	—	—	Daylight

mens. In each case, the female seemed reluctant to engage in a tail-walk. The behavior of the females involved was quite characteristic. Whenever the male maneuvered his body or tail into contact with the chin of the female, she raised her head quite high until contact with the male was broken. The male often returned to the female and reestablished contact with her chin but the contact was almost immediately broken again by the female when she raised her head.

The foot dance referred to early in this paper was quite characteristic of the earlier phases of courtship. Unlike *Ensatina escholtzii* (Stebbins, 1949), *P. j. metcalfei* engages in this type of limb movement before tail-walk. The raising and lowering of the limbs by the male produces little or no forward movement. The pattern, if there is any, varies from alternate lifting and lowering of all the limbs as though the male were "marking time" to the alternate raising and lowering of merely the hind limbs or the front

The frequency with which females failed to pick up spermatophores was somewhat surprising. Of a total of 13 spermatophores deposited by captive males, only 4 sperm caps were successfully removed and picked up by females. Five spermatophores were deposited while the salamanders were under observation and, of these, only one was successfully recovered by a female. In most instances, the female passed to one side or the other of the spermatophore. This low incidence of success may well have been due to the confined area of the 8 inch finger bowls in which the salamanders were maintained because the courting pair could not always move forward without turning somewhat.

In only one instance did a male display aggressive behavior during courtship. On August 9 at 10:45 PM, a male was actively courting a female who seemed very reluctant to engage in courtship. She often moved away from the male and tried to escape from the container. This particular female had been

in captivity accustomed to being handled. However, she never heeded contact with the male's head or the eye. She damaged the eye to court when he with five.

At 1:00 AM, a succession of front limbs of another away and at 1:08 AM, a female, female, trying to the male nearby snout of another individual twice ran freed him him around him on the transfer broke off attacked head twice bit the later started her and then a th at 2:00 AM examined spermatophore.

On August 10, in a container on the side of Whitetop mountain, a salamander and tail of the male's tail position for ran. The and both instances of field; none in diurnal.

When a female in the field or in a container tried to escape from the male, she often moved away from the male and tried to escape from the container.

in captivity since July 14 and was presumably accustomed to the container. The male followed her around the container and whenever he placed a part of his body or tail in contact with her chin, she immediately broke contact by raising her head. At 11:24 PM, the male bit her on the side of her head near the eye. She pulled her head back and no damage was observed. The male continued to court her until 1:00 AM on August 10 when he was transferred to another container with five females and three other males.

At 1:05 AM, the transferred male, in rapid succession, bit the tail of a female, the left front limb of a male, and the tail of still another male. The victims moved rapidly away and were apparently undamaged. At 1:08 AM, the transferred male began to court a female that had just molted her skin. The female, however, seemed more intent on trying to locate her shed skin. At 1:11 AM, the male broke off courtship and attacked a nearby stub-tailed male. He bit the tail of another male and returned to the stub-tailed individual. He clamped his jaws over the snout of the latter and both males rolled over twice rather rapidly. The stub-tailed male freed himself and the transferred male chased him around the container repeatedly biting him on the tail and sides. By 1:20 AM, the transferred male was courting a female but broke off courtship after ten minutes and attacked a nearby male biting him on the head twice. At 1:32 AM, the transferred male bit the tail of a female and two minutes later started to court another female. He left her and started to court a second female and then a third. Observations were terminated at 2:00 AM and when the container was again examined later that morning, no evidence of spermatophore deposition was found.

On August 27 at 10:30 AM, while collecting in a deciduous forest on the north facing side of Whitetop mountain, I found two salamanders courting under a log. The body and tail of each were straight and the female had her chin pressed against the base of the male's tail. They remained fixed in this position for a few seconds and then the female ran. The male did not attempt to escape and both were recovered. This is the only instance of diurnal courtship observed in the field; none of the captive specimens engaged in diurnal courtship.

When a courting pair was disturbed, in the field or in captivity, the female immediately tried to escape but the male did not.

#### SPERMATOPHORE DEPOSITION

Shortly after midnight on August 5, three complete spermatophores were removed from a container holding five females and four males. Later that morning, when the container was reexamined, two more jelly stalks were seen without sperm caps. Subsequent examination of the females in the container revealed that two of them had been inseminated and therefore that two successful courtships had occurred after observations were terminated earlier that morning at 2:00 AM. What is more significant, however, is that a total of five spermatophores or stalks were recovered from a container that held only four males. Thus, at least one male had deposited more than one spermatophore during the course of a single night.

Aside from normal spermatophore deposition during courtship with a female, spermatophores were observed to be deposited under various circumstances. On August 5 at 9:55 PM, upon turning on the light in the room containing the captive specimens, a male was observed pressed down against the moist paper toweling at the bottom of his container. His body and tail were straight and he was rocking his pelvis and undulating his tail laterally. No other salamander was near him, although one might have been frightened away when the light was turned on. At 9:59 PM, he deposited a spermatophore. A female, possibly one involved in courtship before the light went on, approached him and placed her chin on the base of his tail. The two then moved forward and stopped but the female had passed to one side of the spermatophore and did not recover it. A second female approached the spermatophore and placed her nasolabial grooves upon it. She remained in this position for about a minute and a half and then moved away.

On August 8 at 10:00 AM, a spermatophore was found in a container in which three males and five females had been confined on August 6. The spermatophore was adhering to a molted skin but was normally formed. On the evening of August 9 at 10:46 PM, a male was in the process of shedding his skin. As the molted skin passed over the region of his vent, a spermatophore was deposited. This may account for the spermatophore found attached to the molted skin on August 8. In this case, however, the spermatophore did not adhere to the skin but was attached to the substratum in a normal manner. The male then proceeded to eat the molted skin

but ignored the spermatophore which was quite close to it.

Finally, abnormal deposition took place on August 5 during a homosexual courtship between two captive males. The two males had initially been courting the same female but when they came in contact they began to court one another. The details of court-

phore. This homosexual mating was probably not an unusual behavior brought about solely by conditions of captivity and crowding because similar observations were made in the field. On the morning of August 4 at 1:30 AM, two specimens were observed in tail-walk in the field but they were disturbed by the presence of the observers and separated

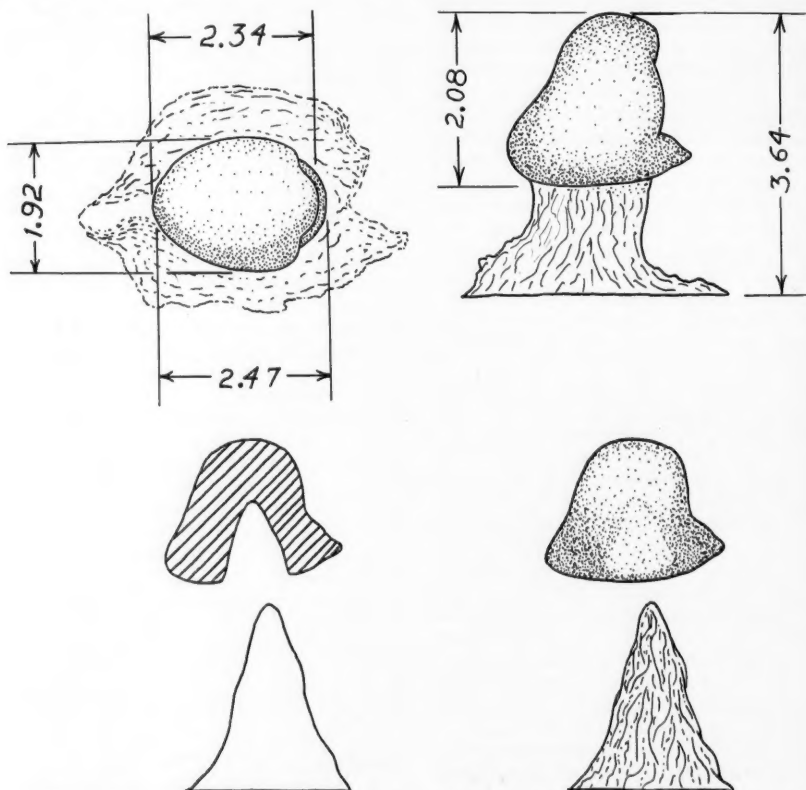


Fig. 3. The spermatophore of *P. j. metcalfi*. a.—Spermatophore viewed from above. b.—Same spermatophore viewed from its right side. c.—Sperm cap and jelly stalk after detachment. d.—Diagrammatic section through sperm cap and jelly stalk. Measurements in millimeters.

ship between these males were essentially the same as those of any normal male-female courtship. The male executing the female role even engaged in lateral head movements counter to the pelvic movements of the male depositing the spermatophore. The males had begun courting at 11:43 PM and the spermatophore was deposited at 11:58 PM. The two males separated immediately after the spermatophore was deposited and there was no attempt to pick up the spermatophore.

as they attempted to escape. When the two specimens were recovered, they both proved to be males.

#### SPERMATOPHORE

The only spermatophore recovered from the field was that deposited on August 3. This specimen was recovered by cutting the bark from the branch to which the spermatophore adhered. The spermatophore, still attached to the bark, was brought back to the

cabin and ink within the field. The measurements to this spermatophore in captivity covered the caps had

The spermatophore were identical in the field. The size and shape were different. It is common to have a pale buff color, is asymmetric or ridge surface, and can be of the same size. Of the same size, the depositing the lip was of the same size.

Not only different in shape, but also in size. Noble & also the attached jelly stalk, sperm cap as a removed gastrula cap, in which the open whorls a fresh surface was of the surface of either the had not the stalk substratum, in which the observed spermatophore.

The fact that were found amander spermatophore up or p as is the (1929). The by exam

cabin and measured and drawn in pen and ink within 15 minutes after it was deposited in the field. It is shown, along with its measurements, in Figures 3a and 3b. In addition to this one field specimen, nine complete spermatophores were recovered after deposition in captivity and four jelly stalks were recovered from spermatophores after the sperm caps had been removed by captive females.

The spermatophores deposited in captivity were identical to that recovered from the field. They are remarkably constant in form and size. The spermatophore of *P. j. metcalfei*, when freshly deposited, is mushroom shaped. It is composed of a clear jelly stalk with a pale buff colored sperm cap. The sperm cap is asymmetrical and dome shaped with a lip or ridge projecting from its anterioventral surface. This lower lip is quite characteristic and can be used to orient the spermatophore. Of the six spermatophores observed during deposition, both in the field and in captivity, the lip was always oriented towards the head of the male depositing the spermatophore.

Not only is the shape of the spermatophore different from previous descriptions of plethodontid spermatophores (Noble, 1929; Noble & Weber, 1929; Gorman, 1956), but also the method by which the sperm cap is attached to the jelly stalk is different. The jelly stalk has a smaller diameter than the sperm cap and extends into the center of the cap as a sharp spike. The sperm cap, when removed from the jelly stalk, resembles a gastrula (Figs. 3c and 3d). Furthermore the cap, in a fresh specimen, is very easily detached from the jelly stalk. The cavity, into which the jelly stalk had projected, remained open when the sperm cap was removed from a fresh specimen. The surface of the cavity was of the same texture as that of the outer surface of the cap and no sperm oozed from either the cavity or the outer surface. The cap had not been ruptured by detachment from the stalk. The stalk remained attached to the substratum as a conical spike which was identical in form to that left after a female was observed picking up a sperm cap from a spermatophore.

The ease of detachment together with the fact that three other spike-like jelly stalks were found in containers with captive salamanders indicates that the jelly stalk of the spermatophore of *P. j. metcalfei* is not picked up or pinched off along with the sperm cap as is the case in *P. cinereus* (Noble & Weber, 1929). This statement is further strengthened by examination of two females which had

been freshly inseminated in captivity. In each case, there was no trace of a jelly stalk attached to the cap once it had been picked up by the female. The sperm cap was not apparent until the vents of the females had been spread open by a pair of forceps. The sperm cap, as is typical in the Plethodontidae, was stored towards the rear of the vent.

#### DISCUSSION

The courtship of *P. j. metcalfei* agrees quite well with the generalized plethodontid pattern described by Noble and Brady (1930) but these workers made no mention of the raising and lowering of the male's limbs during the initial stages of courtship. Stebbins (1949) described a similar limb movement in male *Ensatina*. In the latter, however, the limb movements were not evident until after the tail-walk had begun.

The tail in *P. j. metcalfei* does not play as prominent a role in courtship as does that of *Ensatina*. The tail of the male *P. j. metcalfei* is not hooked over the hind limb of the female nor is it curved over the back of the female while she picks up the spermatophore.

The olfactory system probably plays an important role in courtship. During the initial stages of courtship, the male often touched his nasolabial grooves to the substratum as though he were searching for the female. Having made contact with the female, the male's nasolabial grooves were in almost constant contact with the skin of the female until he circled under her chin and led her in the tail-walk.

The olfactory system may be just as important in helping the female to orient during courtship. This is suggested by the behavior of the female who approached a freshly deposited spermatophore and remained with her nasolabial grooves in contact with it for a minute and a half. The scent of the spermatophore must certainly have been the same as the male's vent. This scent, however, was not sufficient to hold the female's attention for a long period of time. The combination of scent and tail undulations from the male is probably sufficient to evoke and maintain interest on the part of the female and to keep her oriented at the base of the male's tail over his vent.

Since at least one spermatophore was deposited while a male was shedding his skin, it may be concluded that the spermatophore is formed and retained in the vent of the male prior to courtship.

The aggressiveness displayed by one cap-

tive male may have been unusual and until future field observations confirm this behavior, it must remain uncertain that this is a normal behavior pattern occurring in the field and not the result of conditions of captivity.

The conditions under which courtship occurred in the field seem to be rather variable. Since one courtship was observed during the day and one other just after dusk, it is assumed that total darkness is not an absolute requirement for courtship. Leaving a light on in a room with captive specimens seemed to disturb them less than turning a light on or off. Captive females seemed to be more disturbed by the light, however, than did the males. This may indicate a greater level of excitement on the part of the male during the courting season. Certainly whenever a courting pair was disturbed, either in the field or in captivity, it was always the female who immediately ran for cover. The male seemed to be less aware of his surroundings during courtship and especially during spermatophore deposition. In short, during the proper season, courtship in *P. j. metcalfei* will occur under almost any field conditions and special stimuli like rain, high humidity, or total darkness do not seem to play a very great role in evoking courtship activity.

The structure of the spermatophore in this species is unusual; future work should be directed towards discovering the mechanism whereby the spermatophore is formed with the jelly stalk extending well into the center of the sperm cap.

The courtship season for *P. j. metcalfei* at Whitetop mountain, Virginia, extends at least from August 3 to August 27. The season is probably much longer but no courting pairs were observed during the month of July, even though much time was spent in the field at night during that period.

I suggest that courtship in the other subspecies of *Plethodon jordani* also occurs during late summer.

#### SUMMARY

Courtship in *Plethodon jordani metcalfei* observed in the field and in captivity consists of a series of rather stereotyped phases somewhat variable in details.

The male approaches the female and executes a series of nosing movements with his snout. The male places his nasolabial grooves and mental gland in contact with the skin of the female and moves towards her head while

executing a foot dance. At the head of the female, he places his mental gland and nasolabial grooves between her eyes and over her snout and then circles under the chin of the female.

The male and female engage in a tail-walk and then the male executes a series of lateral pelvic rocking motions while the female executes lateral head movements counter to the movements of the male. The male deposits a spermatophore, arches the tail and moves forward with the female until her vent is over the spermatophore. The female picks up the sperm cap from the spermatophore with her vent but leaves the entire jelly stalk attached to the substratum.

A male *P. j. metcalfei* is capable of depositing more than one spermatophore in a single night.

One courting male displayed aggressiveness and attacked females and other males by biting them.

Male *P. j. metcalfei* may sometimes engage in homosexual courtship which may result in spermatophore deposition.

Spermatophores may be deposited when a male sheds his skin indicating that the spermatophore is formed and retained in the vent of the male prior to courtship.

The spermatophore of *P. j. metcalfei* is mushroom shaped and constant in appearance. It is composed of a spike-like jelly stalk extending into the center of a light buff colored sperm cap which is easily detached from the stalk. The sperm cap has a characteristic projecting lip on its anteroventral surface.

Courtship usually occurs at night between dusk and dawn but may occasionally occur during the day when specimens are under cover.

The breeding season for *P. j. metcalfei* on Whitetop mountain, Virginia, extends at least from August 3 to August 27.

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## A New Species of *Sauromalus* from Mexico

FRANK S. CLIFF

THE 1952 and 1953 Sefton-Stanford expeditions to the Gulf of California collected reptiles that were deposited in the Natural History Museum of Stanford University. A report has been published on the snakes (Cliff, 1954). This paper is the first in a series dealing with the lizards found on the Gulf islands.

### *Sauromalus ater* DUMERIL, 1856

*Sauromalus ater* is known from the following Gulf of California islands: Espiritu Santo, San Francisco, San Jose, San Diego and Santa Cruz. It is not known from the mainland of Baja California. Three specimens from San Jose Island, Stanford Natural History Museum register Nos. 15722 and 16139-40, constitute a new record for this species.

The three specimens from San Jose Island are typical of this species in scale counts: ventrals number 125-135-136, caudals 29-29-29, humerals 39-40-44 and central dorsal scales per head length 28-31-32. In coloration, however, these three specimens are somewhat different. The dorsal transverse bands are almost obsolete; the yellow ground color has invaded them and they are broken into a reticulate pattern. Specimens from the other islands are generally somewhat darker and have four or five dark transverse bands, sometimes with light centers, but are not reticulate. Spots may be present in the interspaces between the transverse bands.

### *Sauromalus shawi*, sp. nov.

HOLOTYPE.—SU 16120, collected on San Marcos Island by James Böhlke and Jay M. Savage on April 22, 1952. There are five paratypes (SU 16121-5) collected by Böhlke, Savage and Jon Lindbergh on April 22 and 23, 1952.

*Diagnosis*.—An insular species most closely

related to *S. ater* from which it can be distinguished in having large, acutely pointed scales in the lateral neck fold, almost equal in size to the largest scales on the top of the head, and by its especially pronounced lateral neck fold. It differs from *S. klauberi* in having transverse bands, and from *S. slevini* in possessing a higher number of ventral scales. It differs from *S. australis* in possessing fewer ventral scales and fewer caudals.

*Description of type*.—Form stout, body laterally compressed. The head is swollen lateral to the commissure, above the tympanum and to a lesser extent above the eye; it tapers to an obtuse point anteriorly and is rounded, rather than truncate when viewed from above. The top and sides of the head are covered by scales that are not imbricate, except for the two lateral series above and including the supralabials. The largest scales of the head are on the crown between the nostril and the eye and immediately anterior to the tympanic opening. There is a series of 7 large scales beneath the eye which increases in size posteriorly. The nostril is pierced in a single scale, is directed upward and slightly anteriorly and is much closer to the rostral than the eye. The rostral scale is about the same height and about twice the length of a supralabial. The supralabials are about the same size as the infralabials, subequal, although they increase slightly in size posteriorly. Posterior to the commissure and in line with the supralabials are three enlarged, obtusely pointed scales. The ear opening is nearly vertical and is bordered anteriorly by 4 enlarged pointed scales with their apices directed posteriorly.

Posterior to the ear opening there is a pronounced lateral neck fold. The posterior and lateral edges of this fold bear enlarged and pointed scales. These enlarged scales are



equal in size to the largest scales on the crown of the head, but are not as large as the scales immediately anterior to the ear opening or the greatly enlarged scales which form the anterior border of this opening. The lateral neck fold scales are a flattened cone shape with a large rounded base and have their apices directed laterally and posteriorly. Mesially the lateral neck fold scales become reduced in size, however, they remain rather acutely pointed and are arranged in transverse rows.

The dorsal scales are arranged in transverse rows, are imbricate and decrease in size slightly laterally. In the area bordering the strong lateral fold the scales are enlarged and are about the same size as the median dorsal scales. The dorsal scales merge with the scales of the tail with no appreciable difference in size or in shape.

The mental scale is about the same width as the infralabials and is about twice as high as the infralabials, curving posteriorly to terminate in a rounded point. The anterior scales of the throat are rounded and imbricate and merge posteriorly with the transversely arranged imbricate and dully mucronate scales of the throat. There is a well developed gular fold. The scales of the ventrum are slightly smaller than the dorsal scales, arranged transversely and feebly mucronate.

The dorsal and lateral scales of the forelimbs are imbricate, keeled and enlarged, larger than the median dorsal scales. The inferior surface of the forelimb bears scales that are smaller, weakly imbricate and unkeeled. The scales of the hindlimb are enlarged dorsally and laterally and smaller ventrally, similar to the lepidosis of the forelimb. On the ventral surface of the hindlimb, near its posterior lateral edge, are a series of large femoral pores which extend from the limb insertion to the distal end of the femur. Of the five digits of the forelimb, the third and fourth are the largest, the first the smallest. Of the five digits of the hindlimb the fourth is the largest, the first the smallest.

The tail is depressed at its base and reaches its greatest diameter a short distance posterior to its insertion. From this point distally it becomes rounded and tapers slowly to a rounded tip. It is covered by whorls of scales that are keeled and pointed dorsally, and flat and almost square ventrally.

**Coloration.**—The following notes on coloration pertain to specimens fixed in formaldehyde and then transferred to alcohol.

The top of the head is dark brown as is the region from the ear opening to the eye. Laterally, anterior to the eye, the color is gray punctuated lightly with dark brown. The region lateral and posterior to the ear is dark brown with lighter, dark yellow suffusions. The dorsal ground color is dark yellow with four indistinct dark brown transverse bands. In addition there is a light median dorsal area of a lighter yellow. On the sides are a series of spots. The outline of the dorsal bands is evident although the centers of these bands have been invaded by the lighter dorsal ground color resulting in a reticulated pattern in these areas. The ventral surface has a ground color somewhat lighter than the dorsal ground color. The throat, neck ventral surface of the forelimb and hindlimb are irregularly marked with spots and blotches of dark brown. The dorsal surfaces of the limbs are light brown freely spotted with dark brown. The tail is unicolor light brown with no punctations either dorsally or ventrally.

**Measurements and counts.**—Head length 35.5 mm., greatest head width 33.2 mm., length snout to anus 162 mm., tail length 182 mm., length from forelimb insertion to hindlimb insertion 22 mm. There are 133 ventral scales from gular fold to vent, 30 central medial dorsal scales, contained in one head length, 30 caudal scales (in a whorl, counted two head lengths distally from the vent) and 40 scales (humeral) around the center of the forelimb.

**Summary of paratypes.**—The three females (16121–23) have slightly smaller lateral neck folds and smaller scales in that region. 16124–25, the males of the series, have as large lateral neck folds and scales in that region as does the type. In details of squamation the paratypes are similar to the type. The variation exhibited is as follows: ventral scales 125–132, average 129.0, caudals in a whorl two head lengths from anus 30, central dorsal scales per head length 25–29, average 27.6, humerals 36–41, average 37.6. In details of coloration these specimens vary only in the degree of evidence of the transverse dark bands, the smaller specimens having the bands more clearly defined.

**Relationships.**—This species seems to occupy an intermediate position between *S. ater* and *S. klauberi* as regards coloration and squamation. *S. slevisi*, which occurs on the islands immediately north of *S. ater* and *S. klauberi*, seems to be distinctly separate from these two species and closely related to *S.*

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*hispidus* from the northern regions of the Gulf. Thus there is a gap of over 100 miles between the three closely related insular species *ater*, *klauberi* and *shawi*. This strange gap is emphasized by the fact that *S. slevini* occurs on islands between *S. shawi* and *S. klauberi*. All three of these insular species are probably relicts of a population which once ranged of the mainland of Baja California. *S. australis* which now occurs on the southern half of the peninsula seems to be more closely related to *S. obesus*.

This species is named for Mr. Charles Shaw of the San Diego Zoo, a student of the genus, who suggested (1945, p. 286) that,

if more specimens were available for study, that they might warrant specific recognition.

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## Intergradation Between Two Subspecies of Painted Turtle, Genus *Chrysemys*

WILBUR L. HARTMAN

THE genus *Chrysemys* is composed of four subspecies (Schmidt, 1953). These turtles are found commonly over most of continental United States (except for the far Southwest), part of northern Mexico, and southern Canada. Bishop and Schmidt (1931) reviewed the general picture of intergradation between these subspecies. Since then additional specimens collected primarily in New York State and New England have been examined. The main objective of this study is to describe intergrading characters in mathematical terms, then to restate the intergradation problem on the basis of the new material.

The two subspecies are the midland painted turtle, *Chrysemys picta marginata* (Agassiz), and the eastern painted turtle, *Chrysemys picta picta* (Schneider). Their ranges are given in Figure 1 (after Carr, 1952). Bishop and Schmidt (1931) found intergradation in a narrow area in eastern New York.

#### MATERIALS AND METHODS

Twenty-four collections of *Chrysemys*, totaling 193 specimens, were examined. About half the specimens came from collections at the American Museum of Natural History (AMNH), the Harvard University Museum of Comparative Zoology (MCZ), and the Yale University Peabody Museum (PM). The remaining specimens, collected by the author and associates, are deposited in the Cornell

University herpetological collection (CU). Collection locations are plotted in Figure 1.

Three chief characters are used to distinguish the two subspecies. Most commonly used is the position of the central and lateral laminae on the carapace (terminology of Carr, 1952). Seams separating the central and lateral laminae are in nearly the same transverse line in *picta*, and in *marginata* they alternate. Another character concerns markings on the plastron. The plastron of *picta* is yellow and unmarked, but *marginata* has a central, symmetrical figure. The third character concerns the color of the anterior margin of the laterals and centrals. The margin is wide and light in *picta*, narrower and not light in *marginata*.

**DISALIGNMENT OF CENTRAL AND LATERAL SEAMS.**—When seams between the central and lateral laminae lie in the same transverse line, they are considered to be 0 percent disaligned; if the seams alternate exactly they are 100 percent disaligned. The first situation is approached in *picta*, and the second in *marginata*. The base point for measuring is the inner end of the seam between laterals 2 and 3 (Fig. 2). The imaginary line from the base point forward and parallel to the longitudinal axis of the carapace, to the point opposite the inner end of the seam between laterals 1 and 2 is measured, and denoted as 1a on the left side, and 2a on the right. The portion of this same imaginary line origi-

nating at the same base point and extending forward to the point opposite the end of the seam between centrals 2 and 3 is measured, and denoted as 1b on the left side, and 2b on the right.

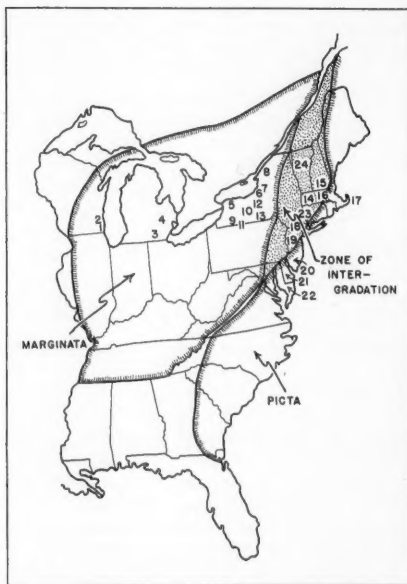


Fig. 1. Locality records of specimens of *Chrysemys* superimposed on a distribution map adapted from Carr (1952: 215): Wisconsin-1, Racine (MCZ, 6); 2, Milwaukee (MCZ, 3). Michigan-3, Ann Arbor (MCZ, 4); 4, Flint (MCZ, 13). New York-5, Sodus Bay (AMNH, 25); 6, Brewerton (CU, 3); 7, Oneida (CU, 3); 8, Potsdam (AMNH, 7); 9, Mecklenburg (CU, 12); 10, Fish hatchery, Ithaca (CU, 20); 11, Cascadilla Creek, Ithaca (CU, 10); 12, farmpond, Dryden (CU, 21); 13, other, Dryden (CU, 5); 18, Rockland County (AMNH, 5). Massachusetts-14, South Amherst (CU, 19); 16, Cambridge (MCZ, 7); 17, Cape Cod (MCZ and AMNH, 12). New Hampshire-15, Milford (MCZ, 8). New Jersey-19, Tenafly (AMNH, 3); 20, Lakehurst (AMNH, 1). Delaware-21, Rehoboth Beach (AMNH, 1). Maryland-22, Federalburg (AMNH, 1). Connecticut-23, Salisbury (PM, 2). Vermont-24, Bridgeport (MCZ, 2).

Perfect, or 100 percent, disalignment (where the seams exactly alternate) occurs when  $1b = \frac{1}{2}1a$ , or  $2b = \frac{1}{2}2a$ . So the actual percentage disalignment for the left side is  $1b/1a \times 2$ , and for the right is  $2b/2a \times 2$ . These two percentages are added together, then divided by 2 to obtain the average percentage of disalignment. This relationship is simplified to give:

Average percent disalignment

$$= \frac{\frac{1b}{1a/2} + \frac{2b}{2a/2}}{2} = \frac{2\left(\frac{1b}{1a} + \frac{2b}{2a}\right)}{2} = \frac{1b}{1a} + \frac{2b}{2a}$$

Specimens were measured with dial calipers calibrated to one-tenth of a millimeter.

THE DARK PLASTRAL FIGURE.—Conant

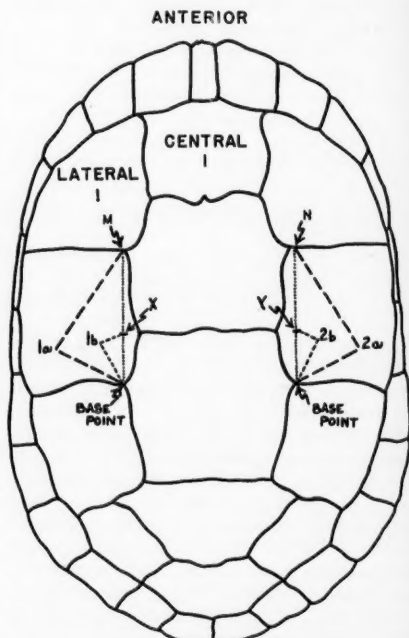


Fig. 2. Carapace of *C. p. marginata* showing measurements for determining percentage of disalignment of central and lateral seams. X and Y are points opposite ends of the seams between Centrals 2 and 3. M and N are points opposite inner ends of the seams between Laterals 1 and 2.

(1951) described the dark plastral figure on *marginata* as large, average, or small sized. Pope (1949) and Carr (1952) stated that it is half or less than half the width of the plastron. A more precise description of the plastral figure is desirable when intergrades are concerned. Most of the plastral figures were distinct enough to be traced on transparent paper. Their actual sizes were compared in relation to plastron length.

THE LIGHT MARGINS.—The light margin on lateral 2 was measured on each side (at

the mid-lateral), and

ALIGNMENT

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the midpoint of the anterior edge of the lateral), and the average width was computed.

#### ALIGNMENT OF LATERAL AND CENTRAL SEAMS

Statistical analysis of collections 1 through 19 (collections 20, 21, and 22 had only one specimen each, and collections 23 and 24 had only two) are given in Figure 3.

Three groups of specimens are statistically significantly different from each other. The statistical analysis used was comparison of standard errors of the mean following

but large figures. Occasionally the plastron of juveniles bears small, darkly pigmented spots or blotches. Frequently these are along the midline, immediately anterior to the anal laminae. In one adult other spots are present farther forward along the midline. In a clutch of 12 hatchlings from Long Island, New York (AMNH) spotting is present in seven individuals. Pope (1949) mentioned this juvenile marking. It seems reasonable to conclude there are likely two types of plastral markings; the distinctive symmetrical figure

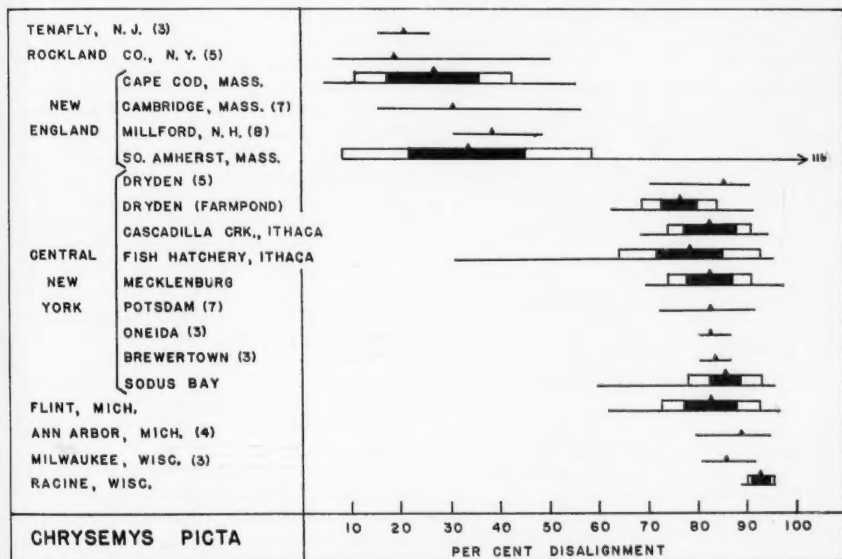


Fig. 3. Percentage of disalignment of central and lateral seams. Line indicates range; triangle indicates the mean; black bar comprises twice the standard error on each side of the mean; and light bar plus  $\frac{1}{2}$  black bar comprises one standard deviation on each side of the mean. The number of specimens in small collections is given in parentheses following the location.

Hubbs and Hubbs (1953). New England specimens have an average disalignment of about 30 percent; Racine, Wisconsin specimens average 93 percent; central New York specimens average about 82 percent.

#### THE DARK PASTRAL FIGURE

Shape, size, and distinctiveness of the plastral figure varies among the specimens examined. Some are compact, others have lateral extensions along seams between the laminae, or the figure may be broken. Occasionally the entire plastron is heavily colored and the figure is obscured. Some specimens, generally with carapace lengths exceeding ten centimeters, have extremely faint

characteristic of *marginata*, and spotting, especially in juveniles of *picta*. Only the symmetrical figure is considered in the following analyses.

Frequency of the plastral figure was computed for three geographical regions. About 75 percent of the Michigan-Wisconsin specimens, and nearly 91 percent of those from central New York show the figure, as contrasted to 2 percent of those from New England. The frequency of this character does not seem to be altered in intergrading areas as does the alignment of carapace laminae.

Plastral figures were also compared for size in relation to plastron length. The dark plastral figure in a specimen from South

Amherst, Massachusetts, (the only one observed in individuals from New England) is comparable in size to those found in many turtles from central New York. Sizes of figures in central New York and Michigan-Wisconsin specimens are also very similar. These data suggest that size of the plastral figure is not reduced among intergrades.

#### THE LIGHT MARGIN OF CARAPACE LAMINAE

The margin of light color on the anterior edge of the carapace laminae in all New England specimens is creamy-white. In specimens from central New York, and Michigan-Wisconsin, the margin ranges from light tan to a dark olive-green, approximating the

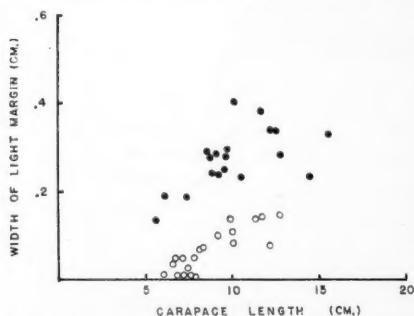


Fig. 4. Width of the light margin of Lateral 3 plotted against carapace length. Specimens are from South Amherst, Massachusetts (●), and Dryden, New York (○).

ground color of the rest of the carapace; none examined is creamy white.

A distinct difference in width of the light margin occurs between the Dryden farm pond collection (No. 12) from central New York, and the one from South Amherst (No. 14) from central New England. These collections have 21 and 19 specimens respectively, and they were taken at nearly the same date in the growing season.

South Amherst specimens have consistently wider margins (Fig. 4). Although not plotted, similar data from the other collections support the conclusion that specimens from New England have consistently wider light margins than do those from central New York, Michigan, and Wisconsin. There are no clear-cut differences between collections from central New York, and Michigan, and Wisconsin.

#### DISCUSSION

Populations of *picta* from New England are clearly separated from *marginata* pop-

ulations as far east as central New York on the basis of percentage of disalignment of central and lateral seams (Fig. 3). Only one of the 46 New England specimens of *picta* has a dark plastral figure, whereas almost all specimens of *marginata* have it. The light margin of some carapace laminae is clearly wider and lighter in color in *picta* (Fig. 4).

Bishop and Schmidt (1931) cast doubt on the validity of records of *picta* from central and western New York. I have examined 106 specimens from central New York and found only one that shows disalignment more nearly like *picta* than *marginata*. However, it does not have a wide light margin on any carapace laminae, and does have a large plastral figure. This specimen was taken from a population that was decidedly *marginata* (collection No. 10), and on the basis of two of the three characters is considered *marginata* also. Perhaps individual specimens like this one have been recorded in the literature as *picta*, but it seems very unlikely that populations of *picta* exist in central and western New York.

Intergradation between these two subspecies seems to involve only one of the three characters studied. Specimens examined have disalignments of the central and lateral laminae ranging from 0 to 100 percent, but no populations studied are exactly intermediate. *Chrysemys p. picta* from New England and *p. marginata* from New York show some degree of intergradation.

The major area of intergradation apparently lies in eastern New York along the Hudson River valley, a region of easy access for *marginata* via the Mohawk River waterway. Bishop and Schmidt (1931) roughly established the north-south limits as Saratoga in the Hudson Valley to Palisades Interstate Park near the New Jersey state line. In determining intergrades they used the three characters mentioned above. The present study confirms their location of the region of intergradation in New York.

This study also provides more information on the location of the eastern edge of the region of intergradation. Intergrades were not found in South Amherst collections from the Connecticut River drainage in Massachusetts. The amount of disalignment (54 and 57 percent) in two specimens from Salisbury in northwestern Connecticut (collection No. 23) suggests that the lower corner of the Hudson River drainage area in New England lies well within the region of intergradation. It is reasonable to assume that much of the other Hudson River drainage area in New England supports populations of intergrades.

The disalignment of central and lateral seams in specimens of *picta* exists in intergrades of the northern part of the middle area.

The area of intergradation is in the Cornell study area. The collection is from the Yale University Museum. The collection is from the nation of E. Snyder, Cornell.

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The disalignment (73 and 78 percent) in two specimens from Bridgeport, Vermont, (collection No. 24) suggests that *marginata* exists in the Lake Champlain drainage. In summation, the eastern edge of the region of intergradation probably lies along the eastern part of the Lake Champlain drainage area in northern New England, and along the eastern part of the Hudson River drainage area in middle and southern New England.

#### ACKNOWLEDGEMENTS

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## The Effect of Temperature on Thyroid Histology and Survival in the Lizard, *Sceloporus occidentalis*

DANIEL C. WILHOFT

#### INTRODUCTION

MANY field and laboratory observations (Cowles and Bogert, 1944; Fitch, 1956) indicate that lizards have an optimal range of temperature at which metabolic processes during periods of activity presumably take place most efficiently. The optimal temperature is here defined as the range of temperature found in individuals voluntarily active on the surface of the ground. Excluded are those animals that have emerged recently and are in the process of warming up. The mean and range of the optimal temperature varies among species (Bogert, 1949a, 1949b; Bullock, 1955), probably within the same species from one locality to another (Rodgers, Unpublished Ph. D. Thesis, 1953), and among individuals (R. C. Stebbins, MS). A daily body temperature cycle is experienced in the temperate zones, which during the active period, may have an amplitude of 20°C. or more. Within this cycle, on days when the temperature is sufficiently high and the animal is abroad, the lizard reaches its optimal temperature range for feeding, courting, territorial behavior and other activities performed during the alert state.

Many lizards have optimal temperatures near that of endotherms, but the environment has been regarded as the prime factor restricting the full use of such temperatures. However, both laboratory and field observations reveal that lizards which seek cover during periods of optimal environmental temperatures are themselves voluntarily restricting the use of optimal temperatures, even though the environment would permit longer periods of exposure at higher temperatures. This would suggest there is not only an optimal temperature level but also an optimal amount of *exposure* to such levels (Stebbins and Eakin, 1958). Undoubtedly this optimum varies with age, sex, season and general physical condition. Although many reptiles have developed stenothermism, which implies a thermoregulatory center of comparable refinement to that of birds and mammals (Rodbert, 1947), their physiology may not be adjusted to a continuous level at the so-called optimum. Therefore, "rest" periods during which the body temperature is reduced may be essential. The present study was initiated in order to ascertain the need of such "rest" periods.

The relationship between metabolic ac-



tivity and the thyroid gland is well known in birds and mammals, but scant information is available on this relationship in reptiles. The first section of this paper consists of a description of the normal seasonal changes in thyroid histology of the western fence lizard, *Sceloporus occidentalis*. The second section constitutes an analysis of the effects of maintaining *Sceloporus occidentalis* constantly at a temperature within the range of its optimum (30–39°C.), as defined above, while at the same time provided with food and water and isolated from other individuals.

#### ACKNOWLEDGMENTS

I wish to express my sincere gratitude to Mr. Harry Spaan of the Western Can Corporation for his generous gift of the containers used in this experiment; to James D. Anderson for his many helpful suggestions; to my wife, Dorothy, for her support and encouragement; and to Dr. Robert C. Stebbins for his never-ending inspiration, interest and assistance; and Dr. Richard M. Eakin for the loan of selected histological material.

#### THE NORMAL THYROID CYCLE

With few exceptions field studies of changes in reptilian thyroid histology have been largely neglected. The pioneer work of Egert (1935, 1936a, 1936b) on thyroid morphology and physiology in the lizards of the genus *Lacerta* demonstrated, in both the laboratory and field, seasonal changes in the thyroid of lizards in the north temperate zone, and presented information on the effects of thyroidectomy and of high and low temperatures. The work of Evans and Hegre (1938, 1940) showed that lizards inhabiting the temperate zone show marked seasonal variation in thyroid histology, whereas those in warmer regions do not. Miller (1955) likewise found cyclic changes in the thyroid of the lizard, *Xantusia vigilis*, a temperate zone form.

#### MATERIALS AND METHODS

The western fence lizard was selected because of availability, ease in maintenance in captivity and knowledge of its temperature preferences.

Beginning in March, 1957, when the first lizards were available after hibernation, a sample of from eight to twelve lizards was collected every month through November, 1957. All animals were taken along a two

mile stretch of dirt road in the hills of Berkeley, California. This sample consisted of at least four adults, two of each sex. The sample was increased during periods when gravid females were present and when the young of the year were hatching. The animal's lower jaw, including the trachea and underlying musculature extending posteriorly to the pectoral girdle was removed and fixed in Bouin's picro-formal acetic fixative within six hours after capture. This tissue was then trimmed, embedded in paraffin, serially sectioned at ten micra and stained with Harris' Alum Hematoxylin and Eosin. Twenty follicles from each gland were randomly selected for measurement. Measurements were of the diameter of the follicle and the height of the follicular epithelium, obtained by using an ocular micrometer (20 mm. diameter; 10 mm. divisions into 200 parts). The ratio of epithelial height to follicular diameter was then expressed as a per cent, and the average of the twenty follicles measured for each animal was computed. The average percentages for each animal in a given sample of males, females, etc. showed no statistical difference, so they were combined for a given month as shown by the numbers above the graphs in Figures 1, 2 and 6. These combined percentages were then treated statistically, to determine the range of variation in epithelial height from month to month and between sexes and age groups.

#### OBSERVATIONS

In the Berkeley area the fence lizard usually emerges from hibernation in late February or early March and mating occurs soon after emergence (Fitch, 1940). Eggs are deposited from mid-May to mid-July and hatching occurs from mid-July to mid-August. Animals return to hibernation in late October or early November depending upon local climatic conditions during any given year.

Beginning at the time of emergence in the spring there is a gradual increase in thyroid epithelial height in adults of both sexes through the period of mating in April or May until June. At this time the epithelial height of females, as based on present evidence, decreases rather rapidly, presumably after egg laying is accomplished. The males begin to show a gradual decrease in July and continue to do so during September when both males and females show the same height as observed upon emergence. A corresponding increase in the juveniles during

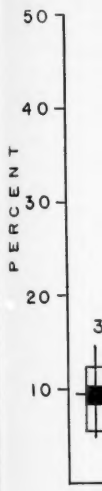


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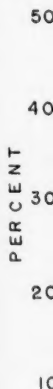


Fig. 2  
legend



the spring is sustained longer than in the adults and reaches a maximum during June and July. In August a decrease begins which culminates at a level of epithelial height higher than the adults at this time, and the level observed upon first emergence. Juve-

niles of both sexes follow the same general epithelial changes throughout this period, differing from the adults which tend to show slight sexual differences. Both sexes and age groups show lowest epithelial height during the winter, judging by thyroid conditions

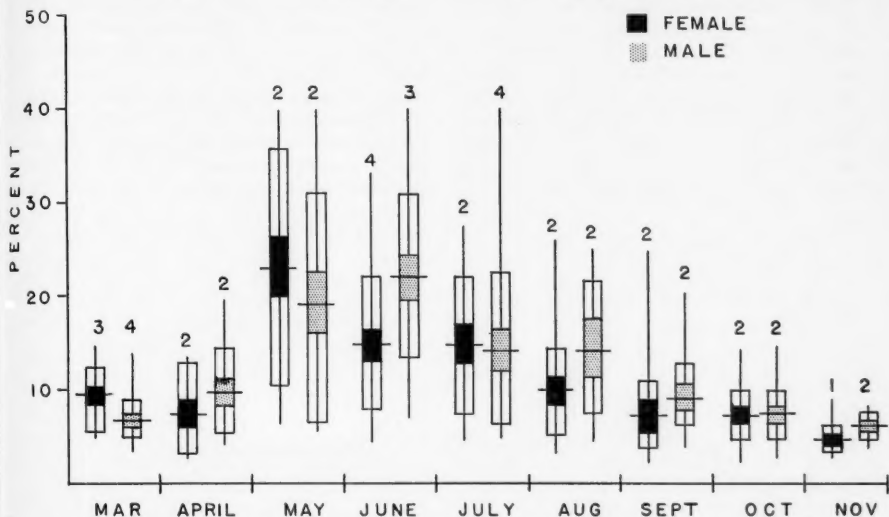


Fig. 1. Seasonal variation in thyroid epithelium of adult *Sceloporus occidentalis* as shown with Dice-Leraas graphs. Open rectangles represent one standard deviation, darkened rectangles represent two standard errors, stippled areas males, solid areas females. Vertical lines represent range, horizontal lines means. Numbers over each graph indicate number of animals in sample for which twenty follicles were measured. See text for explanation of per cent.

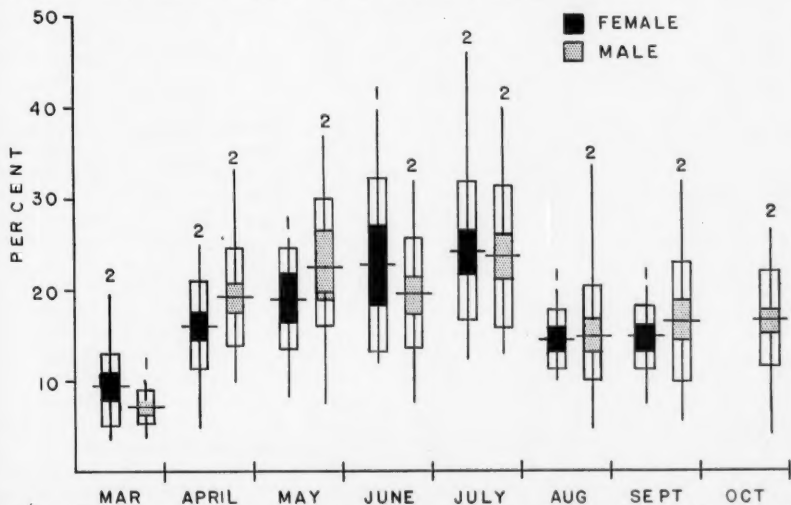


Fig. 2. Seasonal variation in thyroid epithelium of juvenile *Sceloporus occidentalis*. See legend Fig. 1 for explanation of symbols.

just before hibernation in the fall and at emergence in the spring (Figs. 1 and 2).

#### DISCUSSION

Increased activity of the thyroid gland in *Sceloporus* seems to be related to reproductive activity in the adults, growth in the juveniles and amount of time spent at the optimal temperature (see below and experimental phase of report). As assumed from the comparisons of the thyroid of lizards obtained in November and March, there appears to be little change over the winter months when hibernation is in progress. This corresponds to the information available on

sufficient. At the time of emergence in the spring the testes are large and well developed, and the thyroid epithelium relatively low. As breeding takes place soon after this, it is probable that spermatogenesis takes place during a period of low epithelial height. During the early fall (September) there is another increase in testis size, which occurs during a period of decreasing epithelial height. The general increase in lizard activity after emergence in the spring, owing to feeding, courting, defense of territories, etc., might necessitate a gradual increase in thyroid activity in both sexes. The adult females, besides exhibiting a gradual in-

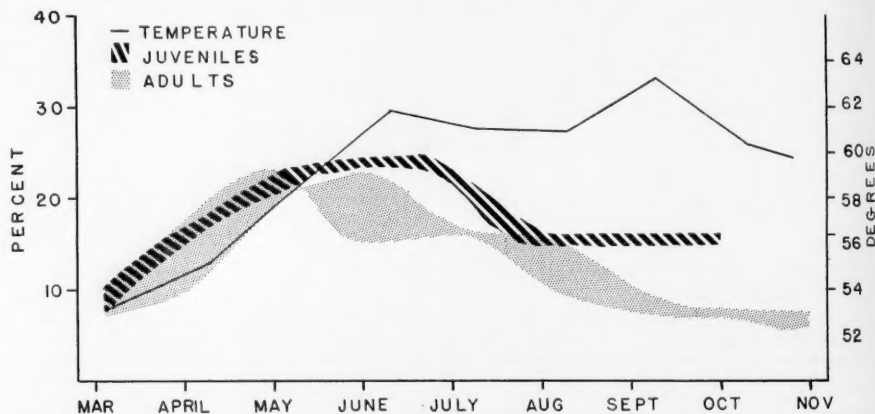


Fig. 3. Seasonal variation in height of thyroid epithelium in both sexes and age classes of *Sceloporus occidentalis* as compared to seasonal changes in air temperature in study area. Stippled lines represent highest and lowest mean in adult and juveniles for any given month. Degrees are in fahrenheit. See text for explanation of per cent.

other reptiles that hibernate in winter [*Lacerta agilis*, *L. vivipara*, and *L. muralis* (Eggert, 1935) and *Chrysemys* (Evans and Hegre, 1940)], whereas reptiles which are active during the winter months show thyroid activity throughout this period, *Anolis carolinensis* (Evans and Hegre, 1938) and *Xantusia vigilis* (Miller, 1955).

As reported by Miller and Robbins (1955) an increase in thyroid gland activity during the reproductive phase of the life history varies with the species. In the fence lizard differences also appear between the sexes. Unfortunately, a complete picture of the reproductive cycle is not yet available. However, for the purpose of this report the work of Altland (1941) on the male fence lizard (*Sceloporus undulatus*) and my unpublished observations on testicular development are

crease in thyroid activity which may be related to feeding, etc., show a marked increase during periods of yolk deposition and ovulation, as has been reported for *Xantusia* (Miller, 1955). This increase appears associated with the presence of estrogens (Evans and Hegre, 1938).

Eggert (1935) suggested that the maintenance of a high epithelium throughout gestation in *Lacerta vivipara* is caused by the gravid female's spending considerable time exposed in the sun. Evidence obtained from observing female fence lizards in the field during the period of pregnancy is scant. However, experimental data reported later in this paper, seem to indicate that increased exposure to optimal temperature is accompanied by an increase in thyroid epithelium regardless of the breeding conditions of males

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or females. Perhaps increased basking by gravid females (*Lacerta*) is indicative of increased exposure to optimal temperature levels. The male fence lizard maintains a high thyroid epithelium longer than the female. This may be related to the more pronounced territorial behavior of the males which may require them to be more active following the breeding season than the females.

Both sexes and age groups show a marked decrease in epithelial height during late August and early September. This period of low activity corresponds very closely with the period of highest temperature for the year (Fig. 3). At this time field observations indicate that the adult animals especially are much less active and that some are estivating.

At times of generally reduced heat juvenile lizards, because of their more favorable surface mass ratio, can take advantage of short periods of heat that are insufficient to bring out the adults. At such times, therefore, they have more opportunity to reach the optimal body temperatures than do the adults. This increased activity, during periods of low temperatures, plus rapid growth might be correlated with their relatively higher thyroid epithelium in October and November when cooler temperatures are encountered.

#### THE EFFECT OF CONTINUOUS OPTIMAL TEMPERATURE ON THYROID HISTOLOGY

As with field studies of thyroid activity in reptiles, little has been done experimentally. Drzewicki (1929), Eggert (1933) and Noble and Bradley (1933) have reported a relationship between the thyroid gland and edycsis in the lizards *Lacerta* and *Hemidactylus*. Recently Ratzersdorfer, Gordon and Charipper (1949), working with *Anolis*, obtained results similar to those of Noble and Bradley from treatment with thiourea. Schaefer (1933) found that thyroidectomy enhances molting in snakes. Scant information is available on the relation between thyroid activity and metabolism in reptiles, although Drexler and von Issekutz (1935) obtained negative results in artificially trying to increase metabolism in turtles, whereas Hopping (1931) obtained some positive results in alligators. Stebbins (unpublished data) reports a relationship between the height of thyroid epithelium and the length of time spent in daily exposure to heat and light.

Bogert and Martin Del Campo (1956) reported paralysis in lizards which were kept for days at optimal body temperatures. Un-

published experimental data obtained from my earlier work suggested a relationship between survival and the duration spent at optimal temperatures in *Sceloporus*.

#### MATERIALS AND METHODS

Thirty-two adult *Sceloporus occidentalis*, sixteen of each sex, collected in September 1957 and of comparable size and weight, were kept for one week without food to obtain a postabsorptive state, then weighed, snout-vent measurements taken, and each placed in a separate numbered container. These containers consisted of round five gallon metal cans, which had the bottoms and inner surface of the sides painted with a mixture of paint and sand. This covering provided a rough surface for easy traction and prevented reflections that might have aroused territorial responses, in the males especially. A watering device, consisting of a stendorf dish with an aluminum cover, and provided with a wick that was constantly kept moist from the water in the dish, was secured to the bottom of each can. Sixteen lizards were placed in the experimental chamber (see below), and the others were placed in the control chamber. The control and experimental groups of lizards both consisted of equal numbers of males and females. The experimental chamber was inside of a walk-in, insulated box, where the temperature was maintained at 34-35°C., the mean of the normal activity range for the animals in the Berkeley area (Stebbins and Eakin, 1958). A continuously recording thermograph placed in this box provided a check on the temperature throughout the duration of the experiment. Light was provided by a fluorescent light unit which supplied an even, but cool light source.

The containers in which the controls were kept were raised to 35°C. for eight hours each day, after which they were allowed to approximate the outside environmental temperature by opening the windows of the control chamber. A thermograph record was kept of the daily fluctuations in temperature for the duration of the experiment. These fluctuations ranged from a high of 35°C. to a low at night of 12°C. Supplementing these readings were readings obtained from thermometers placed in selected containers taken at 8:00 AM and 5:00 PM every day. These supplementary readings corresponded closely to the thermograph records.

The amount of light reaching the bottom of the containers in both experimental and

control conditions was checked with a Weston light meter and found to be the same in each group and in the individual containers. The lights in both chambers were left on continuously.

The overall exposure of both groups to light in the course of the experiment was 2184 hours. Exposure to 35°C. was of similar duration in the experimental group, but only 728 hours in the control group.

Relative humidity readings were taken periodically and a difference was recorded,

to drink water from the wicks, other captive lizards (*Sceloporus undulatus*, *Eumeces skiltonianus* and *Gerrhonotus multicarinatus*) were seen to do so. Each animal was weighed every two weeks and their individual weights combined as experimental and control groups.

Periodically throughout the experiment a small sample from each group was sacrificed in order to ascertain when changes, if any, in thyroid histology were taking place (Fig. 6).

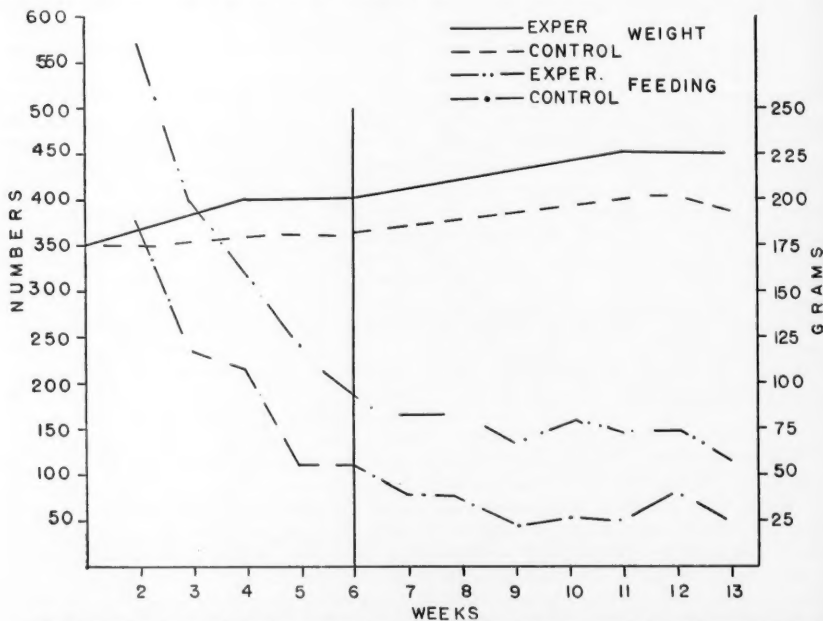


Fig. 4. Comparisons of food consumption and weight between controls and experimental animals. Numbers represent combined total of larvae eaten per week. Grams represent combined body weight of sample per week. Vertical line at six weeks represents point after which compensation for loss of animals was made.

especially during periods of high precipitation. The experimental group averaged consistently lower than the controls, the difference being as high as 15% for short periods during heavy rain. However, since water was always available, the effect of this factor was probably not great.

The lizards were fed mealworms (larvae of *Tenebrio molitor*) daily, and the number of worms consumed by each animal was recorded. Feces were collected from each group and weighed weekly. The water dishes and wicks were kept wet at all times and although none of these animals was observed

#### OBSERVATIONS

During the thirteen-week period of the experiment, six (37%) of the experimental animals died (3 males and 3 females) and none of the controls died. The first of the six animals never ate in captivity and lost 3.9 grams (45%) of body weight in two weeks, death occurring probably from starvation. The second animal also lost weight (1 gm) and fed sporadically. The remaining four, which died between ten and twelve weeks, were eating well and showed an average gain of 4.5 grams per animal (range 3.6 gm-4.8 gm). In these, starvation on a

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As seen in Figure 4, the consumption of food was consistently higher in the experimental group. The relatively higher rate during the first four weeks was probably due to the postabsorptive state the animals were in when the experiment began. The average weight of both controls and experimental animals was very similar at the start of the experiment and both groups showed a progressive increase in weight during the course of the experiment. This was figured on an

especially between the fifth and seventh weeks. At this time more than fifty per cent of the group was shedding as shown in Figure 5. This period of high frequency of shedding corresponds closely to the time of greatest increase in thyroid epithelial height (Fig. 6), as will be discussed below. The shedding was not normal, but rather consisted of a gradual flaking off of the skin.

The thyroid histology of the experimental animals underwent marked changes as compared with the controls (Fig. 7a). At the end of the thirteen weeks, there were six

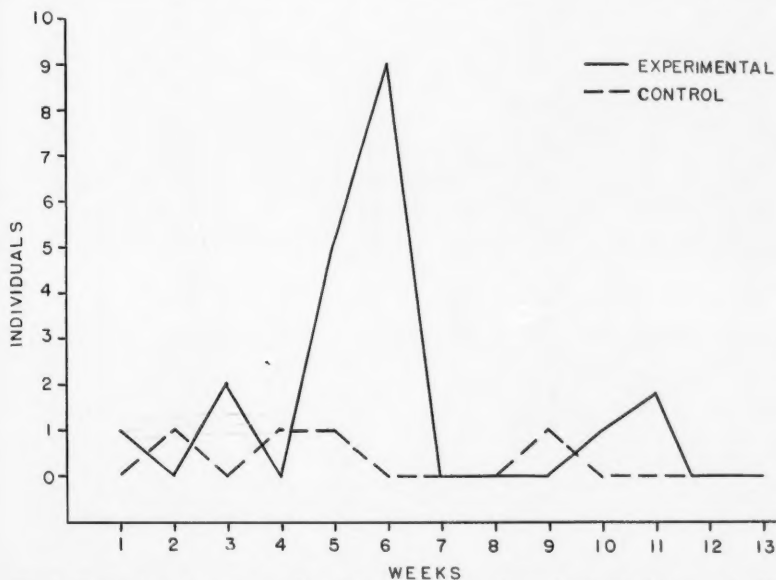


Fig. 5. Comparisons between number of control and experimental animals that were shedding at any one time.

average basis, compensating for the loss of experimental animals (see legend to Fig. 4). Although Fox and Dessauer (1957) reported mealworms alone were apparently sufficient food for *Anolis carolinensis*, a supplementary diet of termite larvae was thought to be advisable. Unfortunately the larvae would not survive more than about an hour at 35°C., and the control animals refused to eat them at all; therefore, a mealworm diet was maintained throughout the experiment. Feces weights, though lower, followed very closely the rate of food consumption in both groups, as would be expected.

Shedding occurred more frequently in the experimental animals than in the controls,

experimental and twelve control lizards left. All the experimentals and six of the controls were sacrificed. The remaining controls were divided into two groups of three animals each; one group was placed in the constant temperature box, the other in the control chamber. Two of these animals (one control and one experimental) were sacrificed at 2, 3 and 4 weeks; this provided an indication of the changes in thyroid histology in experimental animals during early exposure to constant optimal temperature, after being in captivity for fourteen weeks. For convenience they have all been included on the same graph (Fig. 6). The peak of development of the thyroid epithelium ap-

pears to occur at about eight weeks, and after this a slight decrease is apparent. Although at the time of sacrifice the remaining six experimental animals were feeding and no weight loss was observed, their shedding, as mentioned above, was not normal. Rather than risk the loss of information on the thyroid gland by having an animal die and not be found until the next morning, the remainder were sacrificed at this time.

During the course of this experiment, Stebbins found that he could obtain heart rates in *Sceloporus* by counting pulsations in the gular region. The rates were obtained

#### DISCUSSION

Loss of 37% of the experimental animals definitely indicates that there is a detrimental effect resulting from maintaining these lizards at a constant optimal temperature for periods beyond six weeks. The cause of the deaths in these animals, with the exception of the first two, is not known. At the time of death a superficial examination of the internal organs (liver, spleen, gonads and adrenals) was made, and with the exception of an apparent slight enlargement of the adrenals, the internal viscera appeared normal. The higher food consumption, faster

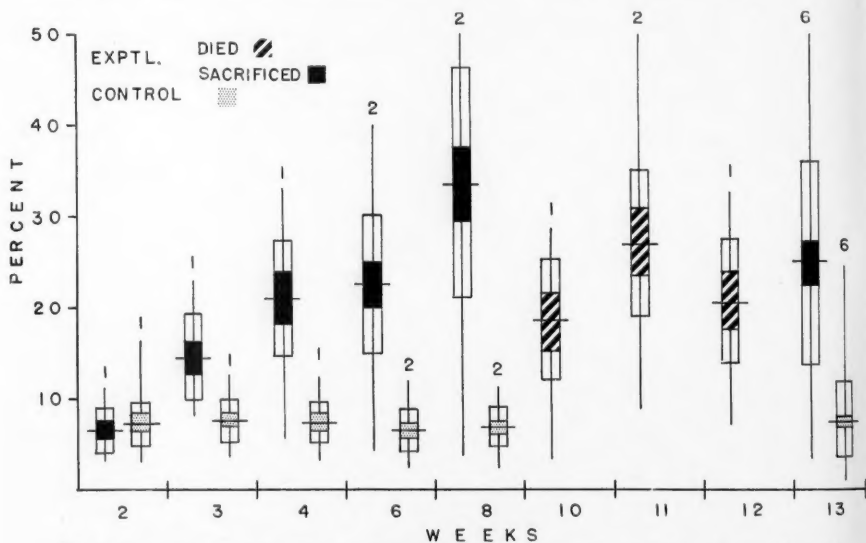


Fig. 6. Comparisons of increase in thyroid epithelium between controls and experimental animals using Dice-Leraas graphs. (For explanation see legend Fig. 1)

numerous times at varying temperatures, and a good correlation between temperature increase and increasing heart rate was found. Animals at 35°C. were found to have a heart rate of 185 beats per minute (range 182-187). The lowest rate of 33 beats per minute (range 32-24), was found in lizards tested at between 13 and 14°C.; lower temperatures were not used. Lizards at between 29 and 30°C. were found to have a rate of 139 beats per minute (range 138-140). It is probable in view of these observations that the experimental animals constantly had a much higher heart rate than the controls, which presumably only experienced the high rate of 185 per minute for a maximum of eight hours per day.

heart rate and increased thyroid activity exhibited by the experimental animals, would suggest a high level of metabolic activity. Assuming that this high level of activity was brought about by the continuous optimal temperature, there was no possibility of relief from this condition, and the animals may have been physiologically "burning themselves out" at a much faster rate than the controls. Accentuation of the effect of nutritional deficiencies inherent in the monotonous diet, may have occurred under the conditions of elevated metabolism.

Regardless of the exact cause of death in the experimental animals, it seems reasonable to assume that although these ectotherms have an optimal temperature near that of



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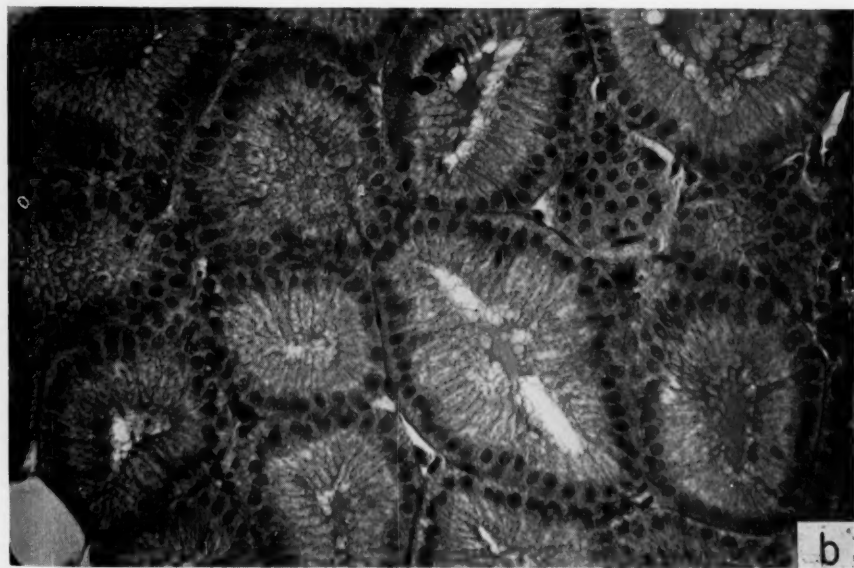
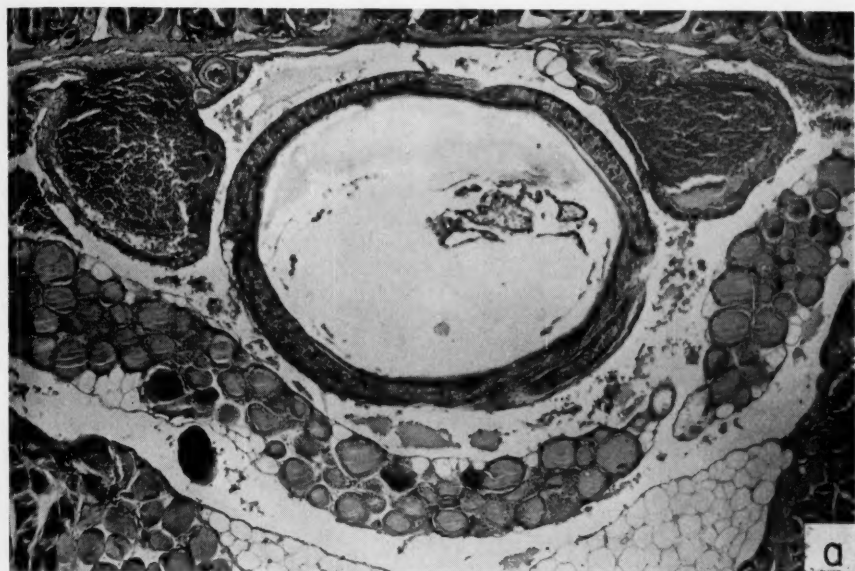


Fig. 7. a. Cross section through posterior gular region, showing the transversely located unpaired thyroid gland lying medially below the trachea.  $\times 83$ .

b. Experimental male animal sacrificed after eight weeks exposure to 35 degrees C. This animal shows maximal increase in thyroid epithelium.  $\times 351$ .



certain endotherms, they cannot remain exposed to this temperature for prolonged periods without harmful physiological effects.

is supported by the work of Drzewicki (1929) and Ratzersdorfer et al. (1949). Injection of thyroxin in thyroidectomized lizards pro-

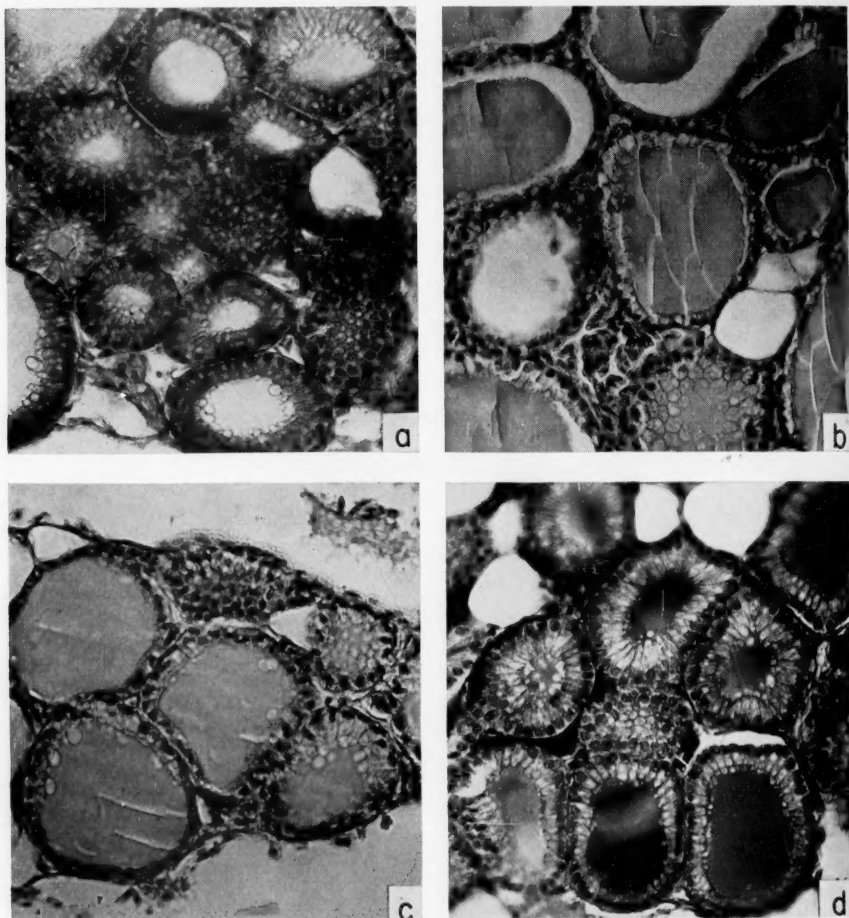


Fig. 8. a. Adult male animal from field population sacrificed in June 1957. This thyroid is characteristic of summer thyroid activity.  $\times 260$ .

b. Adult male animal from the field population sacrificed in November, 1957. This thyroid is characteristic of late fall or early spring thyroid activity.  $\times 260$ .

c. Adult male control animal sacrificed after thirteen weeks exposure to 35 degrees C. temperature.  $\times 260$ .

d. Adult female experimental animal sacrificed after eight weeks exposure to 35 degrees C. temperature.  $\times 260$ .

Noble and Bradley (1933) reported that neither thyroidectomy nor hypophysectomy lengthened the period between molts in the lizard *Hemidactylus brooki*, and neither operation entirely prevented molting. This

duced a return of the molt to its normal periodicity, but increased frequency of molt was not achieved through these injections or fresh lizard thyroid implants. Noble and Bradley (1933) suggest that thyroidectomy

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and hyophysectomy may delay the frequency of molting by simply lowering the rate of metabolism. This can also be brought about by lowering the temperature which brings about a corresponding lower metabolism and eventually a reduced frequency of molting.

Although the duration of the experiment on fence lizards was not long enough to ascertain the frequency of molting of experimental and control animals, the high incidence in the experimental animals at a time when the thyroid epithelium was increasing, suggests a relation between high thyroid epithelium and increased frequency of molt.

#### SUMMARY

1. Seasonal variation in the height of the thyroid epithelium in freshly captured field animals (*Sceloporus occidentalis*) was observed for both adults and juveniles of both sexes. The lowest thyroid epithelial height occurred in winter (Dec.-Feb.), the highest in June and July.

2. Exposure to temperatures considered optimal, defined as the range of temperature found in individuals which are voluntarily active on the surface of the ground, for a period of at least thirteen weeks caused death in some animals, an apparent increase in molting in some, and an increased height of the thyroid epithelium in all animals.

3. It is concluded that although *Sceloporus occidentalis* has an optimal temperature near that of certain endotherms, constant exposure to this temperature is detrimental in that death occurred as a result of this exposure and that it is essential for this ectotherm to have periods of relief from such temperatures.

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## The Pleistocene Herpetofauna of Saber-tooth Cave, Citrus County, Florida

J. ALAN HOLMAN

ONE of the four Pleistocene test faunas of Florida is Saber-tooth Cave (Simpson, 1929). The mammals were described by Simpson (1928) and the birds by Wetmore (1931), but only a few reptiles (Brattstrom, 1953, 1954) and no amphibians have been identified from this locality. Previous knowledge of the fauna of this cave is based upon excavations made by a party from the American Museum of Natural History in 1928. Apparently systematic excavations have not been made in Saber-tooth Cave since this date. On August 9, 1957 extensive collections were obtained at Saber-tooth Cave and the herpetofauna of 21 species forms the subject of the present paper.

Saber-tooth Cave lies in NW¼, SW¼, section 33, T 18 S, R 18 E, 1.2 miles NW of Lecanto, Citrus County, Florida, with an elevation at the top of the cave of approximately 55 feet. The cave is on property presently owned by Mr. Austin Allen. Other names have been applied to this cave in the literature, but it seems wiser to follow Simpson (1928), who uses the name "Saber-tooth Cave," in order to distinguish it from several other caves nearby. A description of the cave is provided by Simpson (*op. cit.*), who mentions that the cave is entered through two vertical shafts. These shafts are about 20 feet in depth. A third and much narrower opening into the cave, which has evidently opened since 1928, was observed by our party.

The matrix of the bone bed consists of reddish sandy clay which is reported by Simpson (1929a and b) and is thought to represent the Wisconsin stage of the Pleistocene. This sandy clay is markedly similar to that of the Pamlico marine terrace, whose top is exposed at 55 feet elevation at a road-cut near Saber-tooth Cave. The Pamlico terrace is thought to represent the Sangamon

stage of the Pleistocene (MacNeil, 1950). The sediments are well stratified in the cave, whereas the terrace sands are massive. This indicates the cave material was transported and reworked from the original Pamlico terrace. The bones, however, show no indication of having been transported, and thus the fossils must have accumulated during post-Sangamon, Wisconsin times.

The 1957 excavation was sponsored by the Florida Geological Survey. The members of the collecting party were Dr. Pierce Brod-korb, Charles J. Flora, and J. Alan Holman of the Department of Biology of the University of Florida. Catalog numbers refer to the collection of the Florida Geological Survey. Exceptionally numerous were insectivores and small rodents. The cotton rat (*Sigmodon hispidus*), mice of the genus *Peromyscus*, and the rice rat (*Oryzomys palustris*) were represented by hundreds of individuals. Birds, reptiles, and amphibians were much less abundant.

Brodkorb (1957) has suggested that the huge Pleistocene rodent beds at Reddick, Florida, could be attributed to the pellets cast by barn owls, and Wetmore (1931) reports three species of owls, including the the barn owl from Saber-tooth Cave. Thus the heavy concentration of rodent and insectivore bones as well as a few of the associated small reptiles and amphibians of various habitats were possibly derived in this manner.

### AMPHIBIA: URODELA

*Plethodon glutinosus* Green.—A single mid-thoracic vertebra FGS V-5735). This is the first record of this genus and species as a fossil.

The middle thoracic vertebrae of *Plethodon* can be separated from species of *Desmognathus*, *Eurycea*, *Manculus*, and *Pseudotriton*

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by characteristics of the anterior end of the neural arch in dorsal aspect. The prezygapophyses are deflected laterally to a greater extent in *Plethodon* than in the other genera studied. The border of the neural arch between the prezygapophyses is rounded in *Plethodon* and more angular in the other genera. The vertebrae of *Plethodon* are much larger than those of *Manculus*. The posterior dorsal portion of the neural arch is notched in *Plethodon* but is bluntly rounded in *Pseudotriton ruber*. A single specimen of *Pseudotriton montanus* examined exhibits this notched condition, but the posterior portion of the neural arch is much more upswept than in *Plethodon*. The fossil vertebra was much larger than those of *P. cinereus*, and the present geographic ranges and ecological requirements of other species of *Plethodon* make it seem unlikely that they existed in the Florida Pleistocene. As the fossil vertebra is identical in size and characters with those of Recent *Plethodon glutinosus*, it is assigned to this species.

#### AMPHIBIA: ANURA

*Microhyla carolinensis* Holbrook.—Right ilium (FGS V-5719). This is the first record of the genus and species from the Pleistocene. Auffenberg (1956a) reports this genus from the Miocene of Florida.

*Scaphiopus holbrooki* Harlan.—Two urostyles, two left and one right ilia (FGS V-5729). Auffenberg (1956a) reports *Scaphiopus* cf. *holbrooki* from the Miocene of Florida, but this is the first Pleistocene record for this genus and species.

*Rana* cf. *pipiens*.—Two sacral vertebrae, six right and eight left ilia (FGS V-5716). Tihen (1954) found that the length width ratio of the centrum of the sacral vertebrae separated the ranid frogs into two groups. The two Saber-tooth fossil sacra are similar to the *R. pipiens* group of Tihen having lengths 2.3 and 2.5 mm. and length-width ratios of .88 and .96. Because of the present geographic range and the uniform small size of the fossils they are tentatively referred to the species *Rana pipiens*.

#### REPTILIA: CHELONIA

*Pseudemys* sp.—Epiplastral elements (FGS V-5733). This element is too fragmentary to be assigned to species.

*Terrepenne carolina* (Linnaeus).—Carapace and plastral elements (FGS V-5734). Barbour and Stetson (1931) include all of the species

of Pleistocene box turtles into the synonymy of *Terrepenne canaliculata* and state the only difference between *T. canaliculata* and Recent *T. carolina* is the larger size of *T. canaliculata*. Millstead (1956) agrees with these workers. Auffenberg (M.S., 1957) further includes *T. canaliculata* in the synonymy of *T. carolina*. The Saber-tooth Cave material includes two large box turtles that do not differ qualitatively from Recent *T. carolina*. In size they more closely approach

TABLE 1  
LENGTH OF MARGINAL SCUTES OF *Terrepenne carolina* IN MM.

Marginal no.	Saber-tooth Cave		<i>T. c. major</i>		<i>T. c. bauri</i>	
	Pleistocene range	Number	Recent range	Number	Recent range	Number
2	18.3-23.7	2	21.3-26.8	2	14.2-20.5	9
4	18.3	1	16.5-24.5	2	12.3-16.3	9
5	17.8	1	19.6-28.0	2	14.7-20.7	9
9	24.4	1	25.0-33.0	2	14.3-22.2	9
10	23.5	1	17.4-26.3	2	12.5-20.5	9
11	16.7	1	16.3-23.5	2	12.0-22.7	9

TABLE 2  
WIDTH OF MARGINAL SCUTES OF *Terrepenne carolina* IN MM.

Marginal no.	Saber-tooth Cave		<i>T. c. major</i>		<i>T. c. bauri</i>	
	Pleistocene range	Number	Recent range	Number	Recent range	Number
2	15.8-17.4	2	18.1-19.4	2	10.5-16.2	9
4	16.7	1	17.7-22.9	2	14.2-17.9	9
5	26.0	1	24.5-32.0	2	14.7-23.4	9
9	23.5	1	20.3-28.8	2	12.2-24.5	9
10	21.4	1	17.4-26.7	2	10.6-18.3	9
11	19.8	1	16.5-26.7	2	12.3-17.1	9

the Recent Florida subspecies *T. c. major* than the Recent Florida *T. c. bauri* (Tables 1 and 2). Enough of a carapace of a box turtle was reconstructed from fragmentary elements to ascertain that the turtle had a very high-domed shell with very little marginal flaring, a characteristic of modern *T. c. bauri*. Recent *T. carolina* major has a more depressed shell. The fourth marginal scute of the fossil was undivided as in most *T. c. bauri*. Those of most *T. c. major* have the scute divided.

*Gopherus* cf. *polyphemus*.—Plastral elements (FGS V-5732), in the absence of more

diagnostic elements the specific identification is tentative.

#### REPTILIA: LACERTILIA

*Anolis carolinensis* Voigt.—Four left, seven right dentaries, three right maxillae (FGS V-5720).

*Rhineura floridana* Baird.—Three posterior vertebrae (FGS V-5722). The Saber-tooth specimens represent the first record of this species as a fossil. Descriptions of extinct fossils of the genus *Rhineura* (Taylor, 1951) have been based on skulls. However, for the identification of Pleistocene species the above posterior vertebrae were diagnostic.

Vertebrae depressed, cotyles and condyles extremely flattened. Neural canals semi-circular anteriorly, circular posteriorly. Width at prezygapophyses more than half the total length of vertebrae. Width and length at prezygapophyses of fossils (2.2,2.9–2.1,2.6–2.1,2.7). Prezygapophyseal faces in shape of parallelograms with acute angles projecting in an anterior direction externally and in a posterior direction internally. Long segments of "parallelograms" parallel to long axis of centra. Prezygapophyseal faces often unsymmetrical, the left or the right being more developed. Postzygapophyseal faces oval in shape and roughly half the area of prezygapophyseal faces. Neural spines low very narrow ridges, highly variable in length and prominence. Low keels variable in prominence, and number occur on either side of neural spines making acute angles with neural spines anteriorly, posteriorly or both. Posterior neural arches somewhat up-swept as narrowly notched lips.

In ventral aspect, dorsal borders of cotyla protrude indented ventral borders. Paradiapophyses large and rounded with subcentral foramina very near their postero-medial border. Centra with two lateral ridges, variable in prominence and with a single depression between them. Posterior centra and condyles somewhat down-swept.

*Ophisaurus ventralis* Linnaeus.—Three thoracic vertebrae and two right dentary bones (FGS V-5718). Auffenberg (1955) gives vertebral characters for separation of the three existing species of *Ophisaurus*.

*Eumeces* sp.—Two dentary bones (FGS V-5736). The tooth count of the single complete dentary in 25, which is not diagnostic at the species level. (Auffenberg, 1956c.)

#### REPTILIA: SERPENTES

Auffenberg (doctoral dissertation, University of Florida, 1956) has reported *Dry-*

*machon corias* from the Saber-tooth deposit and Brattstrom (1953, 1954) has reported *Crotalus adamanteus*, *Crotalus giganteus*, and *Lampropeltis getulus* from this locality.

*Natrix sipedon* Linnaeus.—Four mid-thoracic vertebrae (FGS V-5717).

*Heterodon platyrhinos* Latreille.—Mid-thoracic vertebrae (FGS V-5723).

*Rhadinaea flavilata* Cope.—Three mid-thoracic vertebrae (FGS V-5725).

*Carphophis amoenus* Say.—Seven thoracic vertebrae (FGS V-5721).

*Coluber constrictor* Linnaeus.—Three mid-thoracic vertebrae (FGS V-5730).

*Masticophis flagellum* Shaw.—Two mid-thoracic vertebrae (FGS V-5727).

*Elaphe* sp.—One fragmentary thoracic vertebrae (FGS V-5726). The condition of the vertebrae is such that it cannot be referred to species.

*Micrurus fulvius* Linnaeus.—Twelve mid-thoracic vertebrae (FGS V-5727).

*Ancistrodon piscivorus* Lacpepe.—Two mid-thoracic vertebrae (FGS V-5728).

*Crotalus adamanteus* Beauvois.—Six thoracic vertebrae (FGS V-5717). The six vertebrae from Saber-tooth Cave all fit into the range and variation of seven Recent *Crotalus adamanteus* skeletons in the writer's collection. The largest fossil vertebra represents an individual about five feet in length.

#### DISCUSSION

**Paleoecology.**—The Saber-tooth Pleistocene herpetofauna appears to represent more restricted ecological conditions than does the mammal fossil faunas from the same locality. Simpson (1928) believes the Saber-tooth Cave mammals indicate "a wet lowland with swamps, drier wooded areas and a few open glades." The herpetofauna is very similar to one that could be found today in a Florida pine flatwoods association dotted with small ponds. Only *Plethodon glutinosus*, *Carphophis amoenus*, and *Rhineura floridana* are absent from the above habitat in present times. However, they occur in mesophytic hardwood associations and this type of vegetation characteristically surrounds the mouths of Florida caves.

**Zoogeography.**—Of the still extant fossil reptiles and amphibians from Saber-tooth Cave, only the worm snake (*Carphophis amoenus*) is not found in the same area today. At present *C. amoenus* is found no further south than South Carolina, northern Georgia, and Alabama (Wright and Wright, 1957). Auffenberg (doctoral dissertation, Uni-

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versity of Florida, 1956) has reported *Carphophis amoenus* from Pleistocene localities in Alachua and Marion County, Florida, and thus the Saber-tooth fossils represent a southern extension of the range of this species in the Pleistocene.

It is noted here that Simpson's fossil mammal fauna from Saber-tooth Cave included a pocket gopher (*Thomomys orientalis*) which has its Recent affinities 900 miles westward, a large vole (*Synaptomys australis*) with northern affinities, a capybara (*Hydrochoerus holmesi*) and a deer (*Blastocercus extraneus*) having present South American affinities. The 10 birds identified by Wetmore (1931) are all living in the same area today, however, at Reddick, Florida, 20 per cent of the Pleistocene avifauna of 52 species show affinities either to the north or the southwest (Brodkorb, 1957). From the above data it appears that the reptiles and amphibians have been more stable geographically through the Pleistocene than have the birds and the mammals.

Carr (1940) and Neill (1957) mention that the Florida worm lizard (*Rhineura floridana*) is probably a relict form. The fossil history of the amphisbaenid reptiles is a substantial one in the United States until the Miocene (Taylor, 1951). The genus *Ototriton* is reported from the early Eocene of Wyoming, and by Oligocene times seven species of *Rhineura* as well as two other genera of amphisbaenids were present in Colorado, Wyoming, South Dakota, and Nebraska. At the close of the Oligocene the fossil record of the amphisbaenids ends and does not begin again until *Rhineura floridana* appears in the Pleistocene of Florida.

**Evolutionary aspects.**—With the exception of an extinct giant rattlesnake (*Crotalus giganteus* Brattstrom, 1954) all of the fossil reptiles and amphibians from Saber-tooth Cave represent living forms. Extinction percentages for the entire Saber-tooth fossil fauna are given in Table 3.

The question exists as to the cause of the great extinction of many large mammals at the end of the Pleistocene. Some have suggested that this extinction could be due to environmental fluctuations in the Pleistocene and others that it could be correlated with the rise of man. It appears that if the temperature fluctuations of the Pleistocene were responsible for the extinction of large mammals that a similar extinction would be seen in the poikilothermous animals. This seems not to be the case, however, for 95 per cent of the reptiles and 100 per cent of

the amphibians from the Saber-tooth Cave Pleistocene survive to the present but only 42 per cent of the mammals survive. Moreover, a Pleistocene fauna from the earlier Illinoian stage at Williston, Florida, shows 97 per cent of the reptiles and amphibians surviving to the present with only 76 per cent of the mammals surviving (Holman, masters thesis, University of Florida, 1957).

TABLE 3  
PERCENTAGE OF LIVING AND EXTINCT MEMBERS  
OF THE SABER-TOOTH FOSSIL  
VERTEBRATE FAUNA

	Forms identified	Percentage living	Percentage extinct
Amphibians	4	100	0
Reptiles	20	95	5
Birds	10	100	0
Mammals	24	42	58
Total	58	74	26

#### SUMMARY

1. Twenty-one reptiles and amphibians are identified from the Pleistocene of Saber-tooth Cave, Citrus County, Florida.

2. It is indicated that the deposit represents the Wisconsin Stage of the Pleistocene.

3. The derivation of the fossils is suggested to be due in part to the pellets cast by barn owls.

4. *Plethodon glutinosus*, is added to the fossil record. *Microhyla carolinensis*, *Scaphiopus holbrooki*, and *Rhineura floridana* are reported for the first time from the Pleistocene.

5. A Pleistocene habitat of pine flatwoods with associated ponds is inferred for the Saber-tooth herpetofauna.

6. The range of the worm snake (*Carphophis amoenus*) is extended south to Citrus County, Florida, in the Pleistocene.

7. It is suggested that the reptiles and amphibians in Florida have been much more stable, both geographically and as to rate of extinction through the Pleistocene than have the birds and mammals.

8. The stability of poikilothermous animals through the Pleistocene might indicate that climatic fluctuations were not the primary cause for the extinction of the large mammals.

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## Fatal Bite of Captive African Rear-Fanged Snake (*Dispholidus*)

CLIFFORD H. POPE

Karl P. Schmidt died on the afternoon of September 26, 1957, twenty-four hours after being bitten by a juvenile and somewhat aberrant boomslang (*Dispholidus typus*) of uncertain provenance. The snake was about 26 in. long (estimated as 30 in. by Dr. Schmidt). Neither Dr. Schmidt nor his colleagues considered the bite to be serious because the boomslang was small, the deep wound was made by only one fang, and the victim, though sixty-seven years old, was in good health and spirits. It is hoped that the facts set forth here may shed light on this tragic case and broaden our knowledge of the effects of boomslang venom.

No one can explain why Dr. Schmidt grasped the snake just behind the part of the neck being safely held by Curator Robert F. Inger, instead of maneuvering to exchange grips, as expected. Evidently the movement was made absent-mindedly. Even if the snake had been obviously harmless, it is questionable whether Dr. Schmidt would have consciously given it opportunity to bite. Every herpetologist knows that if he wants to be bitten deeply, he has only to grip a snake a short distance behind the head.

The following account of the bite and its effects was written by Dr. Schmidt out of

scientific curiosity and in a characteristic spirit of optimism. (A first-hand report of an untreated bite has special value.)

"A boomslang with undivided anal plate. —A thirty-inch snake brought for identification to Chicago Natural History Museum by Mr. Truett of the Lincoln Park Zoo, proved to be uncommonly difficult to name. It was known to be an African snake, and with the characteristic head-shape, oblique and keeled dorsal scales, and bright color pattern should have offered no difficulty. But no key for identification would make it a boomslang, for the anal was undivided. That it was nevertheless a boomslang (*Dispholidus typus*) was dramatically attested by its behavior. Mr. Truett, Dr. Robert F. Inger, Hymen Marx, and I were discussing the possibility of its being a boomslang when I took it from Dr. Inger without thinking of any precaution, and it promptly bit me on the fleshy lateral aspect of the first joint of the left thumb. The mouth was widely opened and the bite was made with the rear fangs only, only the right fang entering to its full length of about 3 mm. Only one other tooth mark, from the penultimate tooth, appeared on the thumb when the snake was disengaged. The punctures bled

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September 25.

"4:30–5:30 strong nausea, but without vomiting, during trip to Homewood on suburban train.

"5:30–6:30 strong chill & shaking, followed by fever of 101.7°, which did not persist (blankets and heating pad). Bleeding of mucous membranes in the mouth began about 5:30, apparently mostly from gums.

"8:30 PM Ate 2 pieces milk toast.

"9:00 PM–12:20 AM Slept well. No blood in urine before going to sleep, but very small amount of urine. Urination at 12:20 AM mostly blood, but small in amount. Mouth had bled steadily as shown by dried blood at both angles of mouth.

"A good deal of abdominal pain, mainly from gas, continuing to 1:00 PM, only inadequately relieved by belching.

"A little fitful sleep until 4 AM when I took an enema (bowels having failed to move the previous day).

"Took a glass of water at 4:30 AM, followed by violent nausea and vomiting, the contents of the stomach being the undigested supper. Felt much better and slept until 6:30 AM Sept. 26.

"6:30 AM Temperature 98.2°

"Ate cereal & poached egg on toast & applesauce & coffee for breakfast at 7.

"Slight bleeding is now going on in the bowels, with frequent irritation at the anus. No urine, with an oz. or so of blood about every three hours (instead of the several oz. of urine to be expected). Mouth and nose continuing to bleed, not excessively."

After breakfast Dr. Schmidt was up and active. In fact, he felt so well at about 10:00 o'clock that he telephoned to the Museum to expect him at work the next day. He got up to eat at noon but vomited after lunch and soon began to have difficulty in breathing. This grew worse until his labored efforts could be heard all over the house. At the onset of these alarming symptoms, Mrs. Schmidt called the inhalator squad and the family physician. Attempts at resuscitation at first brought warmth back to Dr. Schmidt's hands and normal color to his face, but his restoral was of short duration. He was transported to the hospital where he arrived shortly before 3:00 PM and was promptly pronounced dead from respiratory paralysis.

The autopsy, performed on September 27 at 9:30 AM, by a coroner's physician, Cook County, Illinois, revealed extensive internal

bleeding. Massive hemorrhages were found in the lumen of the lower two-thirds of the small intestine, and the ascending and transverse colon. Subserous hemorrhages of the small intestine were from 1–5 cm. in diameter. The contents of the descending colon were blood-stained, and the oral mucosa was bloody. The 4 cc. of hemorrhagic urine resembled pure blood.

Bleeding had occurred into the subarachnoid space over the lateral aspect of the left brain hemisphere and anteriorly over the right one. There was free blood in the cerebral ventricles, and an additional hemorrhage over the right side of the cerebellum. Smaller hemorrhages were evident in the eyes and along the thoracic aorta. The renal pelvis of both sides contained fluid blood and clots. The spleen appeared to be enlarged.

Histological examinations essentially confirmed the gross findings. Multiple, often small hemorrhages were found in the brain, in the submucous and subserous layers of the lower segments of the small intestine (ileum), and in the tubular areas (pyramids) of the kidneys as well as near the renal pelvis. Small bleedings had occurred also in the heart wall and in the lungs, but there was no blood in the bronchial lumina. The autopsy report emphasized that capillary damage with peri-capillary hemorrhages appeared to be the main pathological lesions (endothelial injury). Post-mortem blood clots were not prominent features. Death was ascribed to cerebral hemorrhages caused by "venom from the snake bite."

That Dr. Schmidt's optimism was extremely unfortunate is proved by his death, but it must be admitted that there was some justification: The boomslang was very young and only one fang penetrated deeply. However, almost two decades ago careful experimentation by Grasset and Schaafsma (*South African Med. Jour.*, 1940, 14: 236–41) showed that boomslang venom has an extraordinarily high toxicity, even higher than those of such notorious snakes as cobras, kraits, and mambas. This fact alone dictates extreme caution in handling boomslangs of all sizes, even though they be among the most mild tempered of venomous snakes.

Grasset and Schaafsma further proved the presence in boomslang venom of two pronounced toxic elements, one proteolytic, the other coagulant. The latter has immediate effect that may be fatal before its clots are dissolved by the former. The proteolytic principle produces extensive bleeding

throughout the alimentary tract and in other organs. Death may be caused by clots in the pulmonary vessels (emboli). Patently, the direct cause of Dr. Schmidt's death was respiratory failure; contributing factors that may have played a part cannot be readily evaluated. It can only be presumed that respiratory failure was due to coagulation in the lungs. The autopsy was not begun

until about eighteen hours after death. The proteolytic principle may have produced post-mortem hemorrhages as well as the relative fluidity of the blood noticed at autopsy.

A total lack of experience with boomslang venom is largely to blame for the tragic events of September 25 and 26.

389 RIDGE AVENUE, WINNETKA, ILLINOIS.

## *Dikellorhynchus* and *Kanazawaichthys*: Nominal Fish Genera Interpreted as Based on Prejuveniles of *Malacanthus* and *Antennarius*, Respectively<sup>1</sup>

CARL L. HUBBS

LIKE a considerable number of early-named nominal fish genera, two of recent introduction obviously represent what may be termed, for each, the prejuvenile stage of a well-known genus. This generalized term is proposed to cover a diversity of more or less strikingly—often bizarrely—modified pelagic life-history stages, of various marine fishes, that are not appropriately termed either postlarval or juvenile. Examples include the querimana stage of mugilids, and the similar early, pelagic stages, with iridescent blue or green upper parts and bright silvery lower parts, of many diverse genera (Hubbs, 1941: 184); also such highly modified, structurally specialized types as the acronurus stage of acanthurids, the tholichthys stage of chaetodontids, and the rhynchichthys stage of holocentrids. Such stages, taking the names of nominal, synonymized genera, are commonly characterized by strong spines, bony plates, or peculiar body form. Characteristically, prejuveniles metamorphose very rapidly into the juveniles, which are much more like the adult. For this reason, transitional specimens are seldom encountered.

The two recently named genera referred to above are *Dikellorhynchus* Smith (1956) and *Kanazawaichthys* Schultz (1957: 62). Anticipating the following discussion, it may be stated that *Dikellorhynchus incredibilis* Smith was based on the prejuvenile of a species of *Malacanthus*, presumably *M. hoedtii* Bleeker, and that *Kanazawaichthys*

*scutatus* was based on the prejuvenile of *Antennarius radiatus* Garman.

### THE DIKELLORHYNCHUS PREJUVENILE of *Malacanthus*

As Smith pointed out, the 70-mm. specimen on which he based the name *Dikellorhynchus incredibilis* agrees essentially with the species he called *Malacanthus hoedtii* Bleeker, "except for the ridged and spinose head, the peculiar [transverse, anchor-like, bony] rostral projection and the prominently keeled scales." He definitely anticipated what seems to me to be the logical conclusion, that *D. incredibilis* was based on the prejuvenile of some species of *Malacanthus*. Final proof of this view will need await a demonstration of the metamorphosis, which in all probability will prove to be very brief.

Like the analogous prejuveniles of other marine fishes, the dikellorhynchus stage of *Malacanthus* is probably an inhabitant of the open-sea, surface-pelagic habitat, and presumably transforms when it comes into contact with reef water. This view contrasts with Smith's tentative inference expressed in his statement that "the large eye and the nature of the head might indicate that" it "lives at some depth, possibly in the 'Berycid' zone." The unique specimen was found on the beach on the east coast of South Africa, "after an onset of cold water in January 1955." The locality is south of the reported range of the genus, but such young stages of tropical fishes are frequently carried by currents far poleward, where they may suc-

<sup>1</sup> Contributions from the Scripps Institution of Oceanography, New Series

cumb to unaccustomed cold. Such movements seem to have become unusually common in very recent years, particularly, of course, in the summer.

While this paper was in press, there appeared, by coincidence, the description of a supposedly new species of "*Dikellorhynchus*," namely *D. tropidolepis* Berry (1958). This nominal species was based on 18 specimens, about 45 to 60 mm. in standard length, from the stomachs of two dolphinfish, *Coryphaena hippurus* Linnaeus, captured in the Western North Atlantic. Three of these had previously been recorded, and I believe correctly identified, as *Malacanthus plumieri* (Bloch), by Anderson, Gehringer, and Cohen (1956: 54). In reference to the relationship of *Dikellorhynchus* to *Malacanthus* Berry considered four suppositions, namely that the known specimens of *Dikellorhynchus* represent: (1) species characterized [as adults] by the spinose head and scales, (2) larvae of species undescribed as adults, (3) aberrant growth stages of species of *Malacanthus*, and (4) protracted larval stages of those species. I add and adhere to a fifth hypothesis, that they represent the normal pelagic prejuveniles of species of *Malacanthus*. They are no more bizarrely specialized than the prejuveniles of various tropical fishes. This fifth hypothesis is supported by the facts: (1) that *D. incredibilis* differs from *M. hoedtii* of the same ocean only in the characters interpretable as prejuvenile; (2) that *D. tropidolepis* differs from the sympatric *M. plumieri* in the same fashion; (3) that *D. tropidolepis*, as Berry specifies, differs from *D. incredibilis* in the very characters by which *M. plumieri* differs from *M. hoedtii*; and (4) that no specimens of "*Dikellorhynchus*" have been secured among the very extensive collections of recent years in the surface waters of the eastern Pacific, where *Malacanthus* does not occur. The occurrence of the *dikellorhynchus* stage of *M. plumieri* in the stomachs of dolphinfish, along with other organisms of pelagic habit, verifies my theory that this prejuvenile type is pelagic.

#### THE KANAZAWAICHTHYS PREJUVENILE OF *Antennarius*

*Kanazawaichthys scutatus* was proposed by Schultz (1957: 62-64, pl. 14, A), as a new genus and species, on the basis of four small specimens (15.8 to 29.5 mm. in standard length) from the Gulf of Mexico; three were "probably picked up in a dipnet near sur-

face" and one was "taken from stomach of yellowfin tuna."

The genus *Kanazawaichthys* was differentiated "from all other genera in the family by having two pairs of bony plates on the head. The largest pair covers all the dorso-posterior part of the head behind and above the orbits. A small plate is below each eye. Otherwise the genus has the characters of *Antennarius*," Schultz indicated the close agreement of "*Kanazawaichthys scutatus*" with certain species of *Antennarius* in characters that he showed to be of diagnostic value in the taxonomy of the antennariids. The closest agreement was stated to be with the species that he classed in the subgenus *Fowlerichthys*, particularly with *Antennarius radiosus* Garman of the same general region.

The types of *Kanazawaichthys scutatus* differ further from transformed specimens of *Antennarius radiosus* in having the body more compressed and, in side view, more wedge-shaped, and in the plainer coloration (lacking the ocelli, the reticulations, and the bars on the fins of the adult).

Since I first saw the type specimens, prior to the description, I have felt convinced that the differential characters of *Kanazawaichthys scutatus* are ontogenetic and that the nominal genus and species merely represent the prejuvenile stages of some species of *Antennarius*. The fact that the type series overlaps in size some ordinary juveniles (of the related species, *A. ocellatus*) has seemed immaterial, though Schultz (personal communication) relied on this circumstance in retaining the nominal genus and species. In this connection it should be recalled that related species, such as *A. radiosus* and *A. ocellatus*, commonly differ in the size at metamorphosis; that within some species size of transformation varies widely, as the metamorphosis seems to be triggered by shore conditions, whenever they happen to be encountered; and that some fishes shrink in length during metamorphosis.

Schultz, however, did recognize the possibility that his nominal new genus and species represents a life-history stage of a known species. He stated, on page 63: "I suspect this species is pelagic and that these thickened bony plates act as a floating mechanism. Consideration was given to the possibility that this species might represent the young stage of some known species of frogfish and that at a later stage these plates might be lost."

I am very grateful to Leonard P. Schultz for this information and for his permission

to incorporate his new findings and conclusion in this paper. I am also indebted to Royal D. Suttkus, for privileges and suggestions.

Confirmation of the hypothesis that *Kanazawaichthys scutatus* Schultz is a stage in the development, and therefore a synonym, of *Antennarius radiosus* Garman was recently secured when, in company with Schultz, I examined, with the kind permission of Royal D. Suttkus, the series of *A. radiosus* in the fish collection of Tulane University. By rare good fortune one of the thirteen lots, which comprise in all thirty specimens, illustrates nicely the transformation of the prejuvenile (*Kanazawaichthys*) into the ordinary juvenile. This series (TU 6222) of four specimens was collected by Suttkus and Edwin B. Joseph on February 15, 1953 at the

TABLE I  
PECTORAL-RAY COUNTS (BOTH SIDES) IN TWO SPECIES OF *Antennarius*

The counts by Schultz are taken from his 1957 paper (p. 54); those by Hubbs are from specimens, in the Tulane collection, from the Gulf of Mexico.

	Pectoral Rays			
	11	12	13	14
<i>Antennarius radiosus</i>				
Counts by Schultz.....	..	..	99	5
Counts by Hubbs.....	..	4	51	5
<i>Antennarius ocellatus</i>				
Counts by Schultz.....	3	26	3	..
Counts by Hubbs.....	..	3	1	..

northeast end of Grand Isle, Louisiana. It was obtained with a 150' bag seine from over a sand bottom in a maximum depth of 3.5 feet; moderate breakers prevented seining in deeper water and produced a turbid condition. On the previous day, Grand Isle had been subjected to strong winds and five inches of rain.

All other specimens in the Tulane collection are larger, and were trawled by the OREGON.

Series TU 6222 shows not only the fact and type of metamorphosis, but also illustrates variation in size at transformation (or, possibly, shrinkage in length during the process). This lot comprises the following specimens:

Specimen A, judged to be about one-third the way through metamorphosis, is 23.5 mm. in standard length.

Specimen B, judged to be about two-thirds the way through metamorphosis, is 22.5 mm. long.

Specimens C and D, already transformed, are 23.0 and 27.5 mm. long.

Since the types of *K. scutatus* measured 15.8 to 29.5 mm. in standard length, there must be notable variation in size of transformation, or considerable shrinkage during the process (for fishes with this type of development the second alternative seems the less plausible).

Specimen A, in early transformation, conspicuously retains the large turgid (but now only moderately hard) mass between the orbit and the interspace between the third dorsal spine and the origin of the second dorsal, and a trace of the hard swelling on the cheek. It approaches the type figure of *K. scutatus* in the cuneiform outline of the body and is less round than the transformed specimens. It is almost uniformly very pale yellowish in preservative, and shows only a faint rudiment of the basidorsal ocellus. The radial formula, counting, as Schultz obviously did not, the last two elements of the dorsal and anal fin as one ray, is: D<sub>2</sub> 12, A 7, P<sub>1</sub> 13-13; the first five dorsal soft-rays are so weakly branched as to appear simple except under high power; all anal rays are clearly branched. These fin characters are those of *A. radiosus*.

Specimen B, in later transformation, has the postorbital swellings much deflated, though still clearly apparent, and the cheek swellings scarcely perceptible. The body form is more turgid, but still less gibbous than in the transformed specimens. The general color tone is darker than in specimen A. Dark reticulations are beginning to show on the back, and the blotch representing the developing basidorsal ocellus is more conspicuous. The dorsal and anal soft-rays number 12 and 7, respectively, and the pectoral rays number 12 on each side (see discussion below).

Specimens C and D are typical juveniles of *A. radiosus*, with form and color definitely approaching that of the adult. The radial formula in each is the same as in specimen A.

None of the four specimens shows more than the barest trace of filaments on the esca of the illicium and in none are any pectoral rays branched.

It seems clear that all four specimens represent *Antennarius radiosus*, despite the fact that specimen B has 12 pectoral rays on each side—the modal number for *A. ocel-*

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TABLE II

FREQUENCY DISTRIBUTION OF CONDITION OF BONY PLATES AND OF BASIDORSAL OCELLUS IN SMALL SPECIMENS OF *Antennarius radiosus*

Determination by Leonard P. Schultz from specimens in the United States National Museum.

Standard Length, mm.	Bony Plates on Head			Basidorsal Ocellus		
	Superficially Apparent	Covered by normal Skin, Visible on Dissection	Not Apparent	Lacking	Trace	Definitely Developed
16	1	2	..	1	2	..
17	..	2	..	..	2	..
18	1	1	..	..	1	1
19	..	..	..	..	..	..
20	..	3	..	..	1	2
21	..	1	1	..	1	1
22	..	3	1	..	2	2
23	..	3	2	..	..	5
24	..	1	..	..	1	..
25	..	..	..	..	..	..
26	..	..	..	..	..	..
27	..	..	..	..	..	..
28	..	..	..	..	..	..
29	1	..	2	..	..	3
30	1	..	1	..	1	1
31	..	..	1	..	..	1
32	..	..	2	..	..	2

*latus*, not represented in the 104 counts given by Schultz (1957: 54) for *A. radiosus*. But

among the 26 larger specimens of *radiosus* in the Tulane collection I find two with 12 pectoral rays on one side and 13 on the other. In number of pectoral rays the two species seem to overlap somewhat more extensively than Schultz showed (Table I).

Since this paper was written Leonard P. Schultz has confirmed the present interpretation by a re-examination of the specimens of *Antennarius radiosus* of appropriate sizes in the United States National Museum. His findings are presented, with his kind permission, in Table II.

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## *Gobionellus stigmalophius*, a New Goby from the Gulf of Campeche and the Great Bahama Bank

GILES W. MEAD AND JAMES E. BÖHLKE

THE specimens which are described below are from two sources. The holotype was taken on an expedition from the Academy of Natural Sciences of Philadelphia, under the sponsorship of Mr. Charles C. G. Chaplin. This was a part of the Bahama Shore Fish Program being conducted by the Academy's Department of Ichthyology and Herpetology.

The two larger specimens, the paratypes, were taken during the course of the exploratory fishing and gear development work

being carried on in the tropical Atlantic by the U. S. Fish and Wildlife Service.

While the type specimens are from rather widely separated geographic localities and differ enough in size to render comparison difficult, they agree well in scale and fin ray counts, and in general proportions, characters which Ginsburg (1932) considered most important in separating the species of *Gobionellus*. The smallest specimen has been selected as the type in preference to the others because it alone is in good condition.



*Gobionellus stigmalophius* sp. nov.

Fig. 1

*Holotype*: ANSP 81233, 49.0 mm. in standard length (68.5 mm. total length), from station 402, north side of sandy point forming the western tip of Green Cay, Bahamas: Lat. 24° 02' 25" N., Long. 77° 11' 00" W.; July 15, 1957; water: slightly murky; vegetation: none; time: 1500–1700 hours; bottom: clear sand; distance from shore: to about 50 feet; depth of capture: to about 5 feet; method of capture: rotenone; collectors: Charles C. G. Chaplin and Gordon Chaplin, H. Radclyffe Roberts and Radclyffe Roberts, and James Böhlke; water temperature: 87°F.

*Paratypes*: USNM 159590, 1, 76.5 mm. in standard length (118.5 mm. total length),

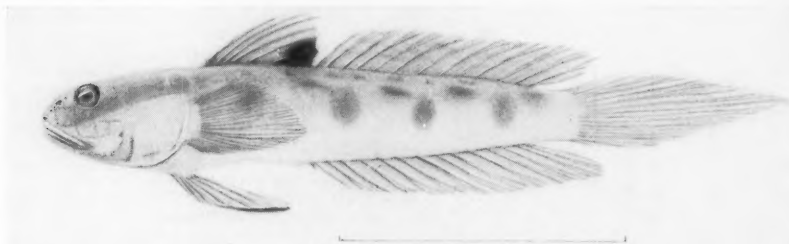


Fig. 1.—*Gobionellus stigmalophius*, holotype, 49.0 mm. in standard length; ANSP 81233. Drawn by Stephen P. Gigliotti

collected by the U. S. Fish and Wildlife Service research vessel Oregon at station 1059 (cruise 22): Gulf of Mexico (Gulf of Campeche): Lat. 18° 43' N., Long. 93° 29' W. Collected with a 40-foot commercial shrimp trawl dragged over a terrigenous gray mud bottom at a depth of 25 fathoms; May 16, 1954; 1855 to 1910 hours.

ANSP 81855, 1, 59.5 mm. in standard length, taken at Oregon station 1058 (cruise 22): Gulf of Mexico (Gulf of Campeche): Lat. 18° 45' N., long. 93° 20' W. Collected with a 40-foot shrimp trawl on a mud bottom at a depth of 22 fathoms; May 16, 1954; 1642 to 1750 hours.

*Diagnosis*: Teeth in upper jaw uniserial; those in lower biserial anteriorly, uniserial posteriorly. All teeth caninoid, but no enlarged canine teeth. Dorsal VI, 13½; anal 14½; pectoral 21 or 22. Caudal fin long and pointed, its length from 1.8–2.5 in the standard length. Anterior body scales cycloid, some of the posterior ones, above the mid-

line, ctenoid; more than 88 in horizontal series. Cheek, opercle and predorsal area scaleless. Ventral fins united and long, extending to origin of anal fin. Membrane between spines of ventral fins well developed. No filamentous extension on spines of first dorsal fin. Anterior nostril with a short tube. A prominent black spot on the spinous dorsal posteriorly.

*Description*: Body elongate and compressed, tapering evenly from the head to the stout caudal peduncle. Greatest depth of body at the insertion of the ventral fins, 1.4–1.6 in length of head. Depth of caudal peduncle 2.4–2.6 in length of head. Head broader than body, its width about two-thirds of its depth. Snout obtuse and uniformly convex, its length 2.2–3.2 in length

of head. Mouth terminal, the upper jaw teeth exposed when the mouth is closed. Gape nearly horizontal, its angle beneath pupil; the larger the individual the further back the angle. Anterior nostril with a short tube located above lip and below a horizontal with lower edge of eye. Posterior nostril larger than anterior, elliptical, level with lower margin of pupil. Eye small, round, superior and encroaching on dorsal profile. Diameter of eye 4.1–4.8 in length of head. Interorbital narrow and concave. Gill opening wide, extending from above the upper end of the pectoral base to the level of the ventral base; width of the isthmus 4.6 to about 6 in length of head.

Teeth on premaxillaries and dentaries only. These jaw teeth are conical, slightly recurved and form a single series which extends from snout to angle of gape and, on lower jaw, from the symphysis to the angle. Those on upper jaw are in a single row. Those on the lower are uniserial

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laterally but biserial anteriorly. A few small teeth are present between the inner and outer rows anteriorly, particularly on the largest specimen. The teeth of the upper jaw are about twice as long and strong as those of the lower. The inner series of mandibular teeth is present only anteriorly and is composed of conical teeth comparable in shape, although somewhat smaller in size, to those of the outer series. The fold of skin across the roof of the mouth behind the jaws is rugose; the papillae forming this patch are slightly stiffened but are not teeth. This patch of papillae is in no way comparable to the inner row of teeth displayed by the specimens of *Gobionellus hastatus* and *G. oceanicus* which we have examined. A patch of well-developed sharp teeth is present on each superior and inferior pharyngeal bone. Vomer and palatines edentulous.

Gill rakers short, flattened and triangular. One on upper limb of first arch, five on the lower. (Since a dissection was required to reveal the branchial chamber, only one paratype was examined.)

Dorsal: VI, 13½. Anal: 14½. Pectoral: 21 or 22.

Distance from snout to origin of dorsal fin 3.1–3.2 in standard length. Spinous dorsal high, the spines increasing in length to the fourth or fifth. Longest spine 1.3–1.5 in length of head. Second dorsal well separated from first, originating over insertion of anal fin; the posterior rays longest, 1.4–1.6 in length of head. Anal fin similar in shape, its origin, like that of the dorsal, a little in advance of the middle of the body. Posterior dorsal and anal rays, when depressed, extend beyond base of caudal. Caudal lanceolate, the mid-caudal rays longest, with those above and below becoming progressively shorter. Seventeen segmented and 14 divided caudal fin rays. Base of caudal fin scaled. Length of caudal fin 1.8–2.5 in standard length, longest in the largest specimen.

Pectoral fin broad; the middle rays either failing to reach anus or just reaching that point. Length of pectoral, measured from base of uppermost ray, 4.4–4.8 in standard length. Ventral fins united, broad, and extending to origin of anal fin. The two ventral spines are connected by a fold which covers the bases of the fin rays. Length of ventral fin 3.6–4.1 in standard length, slightly longer than the pectoral fin.

Scales in horizontal series between upper end of gill opening and base of caudal 89

to about 102. Scales cycloid anteriorly. Some of those above the midline on the posterior two-thirds of the body ctenoid. The posterior scales slightly larger than the anterior. Head naked. Body scales beginning a short distance behind upper end of gill opening.

*Coloration of type* (from the specimen which is in perfect condition but whose pattern is already faint, and from an over-exposed color slide): The most distinct feature of its pigmentation is the jet black blotch at the posterior end of the spinous dorsal fin. Along the middle of the sides are four equally spaced roundish blotches (there may or may not have been a fifth at the caudal base). Above and between these dorsally are irregular, elongate, largely horizontal markings of the same shade and intensity (on the preserved fish). Anteriorly these dorsal markings become less elongate, some nearly circular, smaller, more irregular and broken up. All of these blotches and markings with darker margins than centers. From the photograph, the markings appear golden or bronze in life, though this is not certain since the colors in the photograph are not true. Some irregular markings on snout, which again seem to have darker margins than centers. Ventral cup dusky. Some narrow linear longitudinal markings on vertical fins; several faint concentric bands on caudal.

*Coloration of Campeche Paratypes* (from the specimens which are in rather poor condition).—Mid-lateral body blotches not evident. Posterior spinous dorsal blotch very much in evidence on both specimens. Body coloration dusky, darker in the larger specimen. Upper half of body with an irregular dusky pattern which is more pronounced anteriorly. Black band on free edge of each scale in dorsal half of body. The band on the anterior scales more prominent. Little or no black on scales on ventral half of body. First dorsal fin darker than body, with alternating light and dark patches along spines. Second dorsal and upper half of caudal dusky, with similar light and dark blotches. Distal half of caudal darker than proximal. Anal fin and lower half of caudal uniformly stippled and without pattern. Pectoral fin colorless in the smaller specimen. On the larger, the membrane over each ray is pigmented. Alternating light and dark patches on the membrane between the ventral fin rays. The chromatophores are more dense distally. Buccal cavity and peritoneum dusky.

Measurements, expressed as thousandths of standard length, of the holotype (49.0 mm.) followed, in parentheses, by those of the paratypes (76.5 and 59.5 mm., respectively): greatest depth of body, 184 (196, 185); greatest width of body, 127 (105, 109); least depth of caudal peduncle, 104 (111, 109); greatest depth of head, 190 (170, 193); greatest width of head, 167 (144, 176); length of head 273 (268, 277); length of snout, 087 (105, 126); horizontal diameter of eye, 057 (059, 067); width of fleshy interorbital, 021 (030, 025); length of premaxillary, 120 (137, 118); eye to angle of gape, 072 (085, 084); snout to origin of dorsal, 316 (314, 319); snout to origin of anal, 510 (497, 513); snout to upper end of base of pectoral, 281 (274, 286); snout to insertion of ventral, 237 (248, 286); insertion of ventrals to origin of anal, 278 (229, 269); distance from upper end of base of pectoral to tip of pectoral, 224 (209, 227); length of ventral fin, 276 (255, 244); longest first dorsal spine, 210 (189, 185); longest second dorsal ray, 168 (189, 151); length of midcaudal ray, 398 (549,—).

**Discussion.**—Among the American gobies, *Gobionellus stigmatophius* is most closely related to the more highly modified of its congeners, *G. hastatus* Girard, *G. oceanicus* Gronow and *G. gracillimus* Ginsburg (see Ginsburg, 1932: 6, 35–44; 1953: 24). *G. stigmatophius* resembles these three species in the large number and small size of the scales, the number of second dorsal and anal fin-rays, the greatly attenuated caudal fin and the general form of the body. The new species differs, however, from *G. oceanicus* and *G. hastatus* in several significant respects: uniserial teeth in the upper jaw and biserial in the lower; scaleless operculum; failure of the body scales to extend forward to the upper end of the gill opening; and the greatly elongated ventral fins (which reach to, or beyond, the origin of the anal fin in *G. stigmatophius*). A greater similarity exists between *Gobionellus gracillimus* Ginsburg (1953: 24) from the northern coast of the Gulf of Mexico and our species. Although no figure accompanies the type description of *G. gracillimus* it is apparent that in general shape of the body and fins, length of caudal fin, and type of squamation, the species are quite similar. *G. stigmatophius*, however, has uniserial premaxillary teeth while those of *G. gracillimus* occur in a narrow band. Our specimens have a scaleless area on nape between the origin of the

dorsal fin and the snout while in *G. gracillimus* this area is scaled. Our fish have 21 or 22 pectoral rays; *G. gracillimus* has 18 to 20. Although Ginsburg's specimens were larger than those reported here it is unlikely that these differences are associated with body size. There are also differences in body proportions. Our species has a deeper body (18.4–19.6 percent of standard length cf. 11.0–15 in *gracillimus*), deeper head (17.0–19.3 percent cf. 10.5–13), wider head (14.4–17.6 percent cf. 9–10.5), longer snout (8.7–12.6 cf. 6.5–7.5), larger eye (5.7–6.7 cf. 3.5–5), and longer ventral fins (24.5–27.6 cf. 17.5–21.5).

It may be argued that by having uniserial dentition in the upper jaw *Gobionellus stigmatophius* should more properly be placed in Bleeker's genus *Oxyurichthys* or among the gobies referred to Gill's *Euctenogobius* by Jordan, Evermann and Clark (1930: 442), Meek and Hildebrand (1928: 874, pl. 87) and others. The species included in *Euctenogobius* are separable from *Gobionellus* by having a uniserial row of teeth in the upper jaw and a narrow band of teeth in the lower. Ginsburg (1933: 19; 1953: 23) has discussed the problem and his union of the two genera seems well justified. Although *Gobionellus stigmatophius* is in many respects similar to *G. lolepis* (Meek and Hildebrand) from Balboa, Panama, the long ventral fins, scaleless nape, cheek and operculars, and the greatly elongate caudal fin are among many characteristics in which the two differ. *Gobionellus* and *Oxyurichthys* are also quite similar. Ginsburg (1932: 5) has carefully pointed out that they may be separable by the dentition of the upper jaw: "A single row in *Oxyurichthys*, more than one row in *Gobionellus*." If our species is to be included in *Oxyurichthys*, however, the diagnosis of that genus would have to be emended, just as the characterization of *Gobionellus* must be slightly changed if it is to include *G. stigmatophius* and the species once placed in *Euctenogobius* but referred to *Gobionellus* by Ginsburg. Our species bears a closer resemblance to *Oxyurichthys* than to any of the other Indo-Pacific genera discussed by Koumans (1931; 1953), but is at variance with his diagnosis in several respects: the dentition of the lower jaw, the non-tubular anterior nostril, the scalation, etc. An attempt to reallocate the Pacific and African species related to *Oxyurichthys* leads to difficult situations and a natural

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definition of *Oxyurichthys* must await a re-analysis of the genera on a world-wide basis.

For zoogeographic reasons our fish should more closely resemble the African than the Indo-Pacific species of *Oxyurichthys*. *O. occidentalis* (Boulenger, 1909: 431) is the sole representative of the genus along the West African coast. This species (Boulenger, 1916: 39; Fowler, 1936: 1012) agrees with our fish in the possession of uniserial dentition in the upper jaw but in few other respects. *O. occidentalis* has fewer scales (60–62 in lateral series), non-tubular nostrils, scaled cheeks and operculars, and "ciliated" scales—characters at variance with our specimens. From this discussion it is obvious that these genera, although closely related, are at present poorly defined. Our species is considered here a highly modified *Gobionellus*, and with this inclusion the generic limits of *Gobionellus* and *Oxyurichthys* closely approach one another.

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## The Seminal Vesicles and their Seasonal Changes in the Indian Catfish, *Heteropneustes*<sup>1</sup>

B. I. SUNDARARAJ

#### Key to Abbreviations

- ce Columnar epithelium.  
csd Common spermatic duct.  
ct Connective tissue.  
dc Locules distended with vesicular fluid.  
el Empty locules.  
ger Germinal portion.  
lc Locules in the seminal vesicles.  
nu Nuclei.  
se Squamous epithelium.  
sp Sperms.  
sr Secretory portion.  
tr Transitional region.  
vf Vesicular fluid.

G HOSH and Kar (1952) have described the testicular cycle of *Heteropneustes fossilis*. But there is no reference to the seasonal periodicity of the seminal vesicles. The seminal vesicles were observed in the male *Heteropneustes* in connection with the studies on the correlation between the structure of the pituitary gland and the seasonal changes in the testes (Sundararaj, 1958). Accessory glandular structures to the testis of fishes have received very little at-

<sup>1</sup> This investigation is a portion of the thesis submitted in August, 1957, to the Department of Zoology, University of Mysore, Bangalore, India, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

tention. Rathke (1824) was the first to report on the seminal vesicles of *Gobius niger*. Disselhorst (1904) noticed seminal vesicles in only large males of *Esox lucius* and these observations were made during the spawning time. Eggert (1931) described the structure and the histology of the seminal vesicles of *Periophthalmus chrysospilos*. Young and Fox (1937) have reported on the seminal vesicles of the goby *Gillichthys mirabilis* and on the chemical and physiological nature of

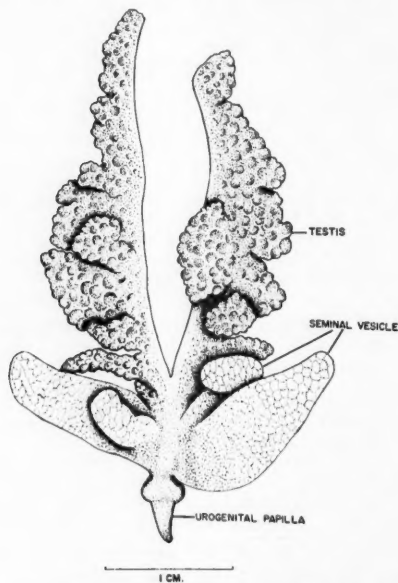


Fig. 1. The testes and the seminal vesicles of *Heteropneustes* during the breeding season. The seminal vesicles are well developed. The vesicle on each side is divided into smaller lobes.

the vesicular fluid. An account of the seminal vesicles of *Chlamydoselachus* is given by Gilbert (1943). Weisel (1949) has described in detail the seminal vesicles of *Gillichthys*. Tavalga (1955) observed seminal vesicles in *Bathygobius soporator*. He also reported that castrated males show a reduction in the size of the seminal vesicles. Nothing is known about the accessory glandular structures of the testes in Indian fishes. The present study was, therefore, undertaken to describe the structure and the seasonal changes of the seminal vesicles of *Heteropneustes fossilis* (Bloch).

#### MATERIALS AND METHODS

To determine the seasonal changes in their reproductive tracts and accessory glands, mature male *Heteropneustes fossilis* were collected every week from Bellandur tank from March 1955 to the end of May 1956. One hundred specimens were used in this study. The length and weight of each fish were noted and the fish were vivisectioned without anesthesia. The seminal vesicles along with the testes were carefully separated, weighed to the nearest milligram and fixed in Bouin's fluid. Transverse sections of the seminal vesicles in paraffin were cut at 12 micra and stained in Heidenhain's hematoxylin and Ehrlich's hematoxylin stains.

The average length of the seminal vesicles were calculated. The average width of the vesicular lumen was determined as follows: (1) the outlines of twelve vesicular lumina were drawn by means of a projection apparatus at a known magnification; (2) the greatest width at right angles to the axes of the vesicular lumen was taken as the diameter and then the average was calculated; (3) the average diameter was divided by the known magnification to obtain the actual average diameter of the vesicular lumina.

#### OBSERVATIONS

##### 1. Seminal vesicles:

The testes of *Heteropneustes* and their seasonal changes have been described in an earlier paper (Sundararaj, 1958). The seminal vesicles are in the form of prominent glandular accessory structures opening at the base of the common spermatic duct (Fig. 1). The seminal vesicles at the height of breeding season have the appearance of greatly enlarged lobules of the testis, containing a yellowish fluid. The vesicles are oval in shape and taper toward the anterior end. Generally, there is a pair of vesicles, one on each side. Occasionally, they may be split into two or even three small vesicles on each side (Fig. 1). The vesicles are bright yellow in color while the testes are whitish.

##### 2. Seasonal changes of the seminal vesicles:

The annual testicular cycle as stated previously (Sundararaj, 1958) is as follows:

- a. Prespawning period (May to July),
- b. Spawning period (August to October),
- c. Postspawning period (November to January), and
- d. Preparatory period (February to April).

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a. *Prespawning period:*

This period comprises the months of May, June and July. During May, the testes are quite active and spermatogenesis is also noticed. Several locules are full of sperms while others are sparse (Sundararaj, 1958).

The seminal vesicles are prominent and their average length is 7.2 mm (Table I). The seminal vesicles open at the base of the common spermatic duct (Fig. 1). The external surface of the vesicles is covered by a connective tissue sheath. The vesicles have numerous small locules or cavities (Fig. 2, 1c). The locules are lined by a secretory epithelium. The epithelium is probably responsible for the secretion of the fluid. Spermatozoa are not found in the vesicles except at the base of the seminal vesicle, where it joins the common spermatic duct. A few spermatozoa are noticed in some of the anterior locules also. The locules probably do not serve primarily for the storage of spermatozoa. In this respect I agree with Weisel (1949). The inner surface of the vesicles is lined by a continuous secretory epithelium. There is only one type of secretory cells lining the cavities of the vesicles. They are either squamous or cuboidal (Fig. 3, se) when the cavities are distended with the fluid or secretion. In those cavities which contain little or no fluid the epithelium is columnar (Figs. 3, 4, ce). The nucleus (Fig. 4, nu) is generally centrally located but occasionally basally also.

The lobes of the vesicles which communicate with the duct appear to be a gradation from the testicular to the vesicular lobes. In the transitional region (Fig. 5, tr) the epithelial lining is partially germinal (Fig. 5, ger) and partially secretory (Fig. 5, sr) as in *Gillichthys* (Weisel, 1949). The various cavities are separated and surrounded by connective tissue sheaths (Figs. 3, 4, ct). The connective tissue sheath in the transitional region is very thick.

The average width of the vesicular lumina is 0.116 mm (Table I). Cavities towards the periphery are filled with the fluid, while those towards the center are empty (Fig. 2). The connective tissue sheath separating the former is thinner than those separating the latter.

During June and July, the testes present the same histological picture as in the previous month. The percentage weight of the testes indicates a slight increase (Table I). The seminal vesicles during these months

have considerably increased in size and their average length in months of June and July is 7.0 and 7.2 mm respectively. Most of the vesicular cavities excepting a few are filled with the vesicular fluid. The vesicular epithelium is cuboidal in those cavities which are completely filled. In the empty locules and in those filled with very little fluid, the vesicular epithelium is columnar. The average width of the vesicular lumina has considerably increased (Table I). The number of cavities distended with the fluid appear to have increased in number.

During the prespawning period, the seminal vesicles as also the vesicular lumina gradually increase in size. The seminal ves-

TABLE I

Month	Percentage wt. of testes	Average length of seminal vesicles in mm.	Average width of the vesicular lumina in mm.
January	0.920	8.5	0.148
February	0.947	8.2	0.150
March	0.717	7.0	0.104
April	0.304	4.6	0.073
May	0.656	7.2	0.116
June	0.673	7.0	0.122
July	0.781	7.2	0.146
August	0.909	11.2	0.226
September	1.580	11.2	0.255
October	1.340	11.7	0.251
November	1.510	10.5	0.238
December	1.260	10.8	0.209

icles also acquire their characteristic yellow color. During this period the vesicular fluid accumulates in the vesicular cavities.

b. *Spawning period:*

During this period the testes attain their maximum size and all the seminiferous tubules are uniformly packed with spermatozoa. Spermatogenesis is not altogether stopped during this period. The males spawn their milt and possibly, the seminal fluid is passed off as a constituent of milt.

The seminal vesicles during August have greatly increased in size and their average length is 11.2 mm (Table I). It is during this month that the seminal vesicles appear prominent and bright yellow in color. The average width of the vesicular lumina also shows an increase (Table I) thereby indicating the accumulation of large quantities



of the vesicular fluid (Fig. 6, dc). A few cavities in the transitional region contain very little fluid in them. The connective tissue separating the cavities is generally thick in the transitional region. The sheath

their milt as indicated by the presence of empty locules in their testes. The seminal vesicles of such specimens have many empty cavities (Fig. 7, cl). This clearly indicates that the vesicular fluid is probably thrown

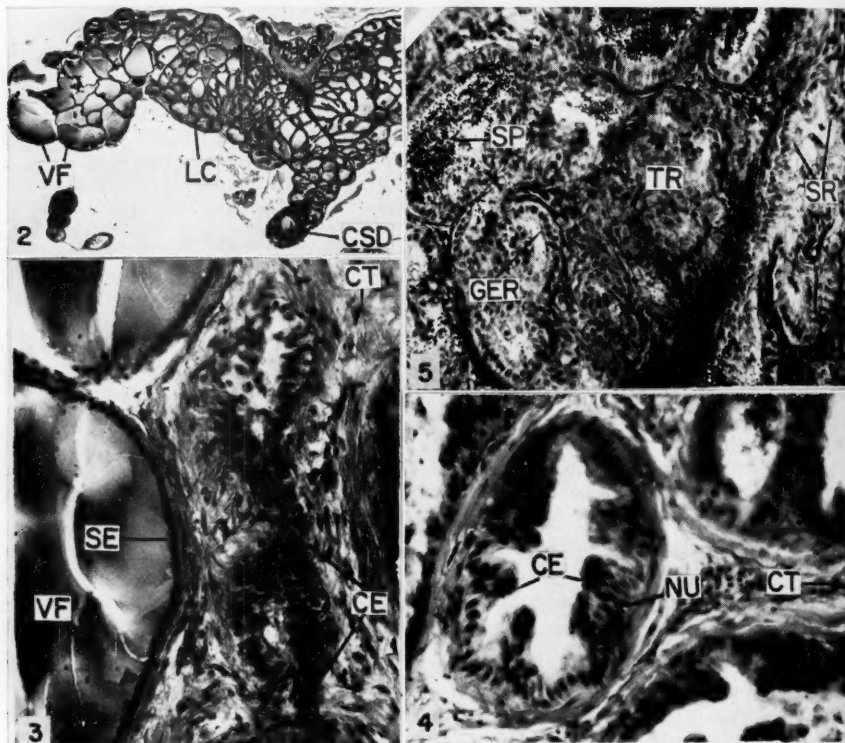


Fig. 2. Transverse section through the seminal vesicles of *Heteropneustes* collected during the prespawning period. Note the presence of numerous locules. Those towards the periphery are distended with the vesicular fluid. Bouin; Ehrlich's hematoxylin  $\times 15$ .

Fig. 3. Enlarged view of a portion of the seminal vesicle of *Heteropneustes* showing the columnar secretory epithelium lining the empty locules and the squamous epithelium lining the locules distended with the vesicular fluid. Bouin; Ehrlich's hematoxylin  $\times 350$ .

Fig. 4. Enlarged view of a portion of the seminal vesicle of *Heteropneustes* showing the columnar epithelium lining the empty locules. Note the prominent nuclei and the thick connective tissue between the locules. Bouin; Ehrlich's hematoxylin  $\times 350$ .

Fig. 5. Transverse section through the transitional region of the seminal vesicle of *Heteropneustes*. Note the presence of masses of sperms in the locules. In some locules the epithelium is germinal while in others it is secretory. Bouin; Ehrlich's hematoxylin  $\times 300$ .

separating the cavities distended with the fluid is very thin.

During September, the seminal vesicles present the same external appearance as in the previous month. The average length of the seminal vesicles is 11.2 mm (Table I) and the average width of the cavities is 0.235 mm (Table I). Some of the specimens during this month appear to have extruded

out along with the milt. Cavities distended with fluid (Fig. 7, dc) are not uncommon. The vesicular epithelium in the empty locules is columnar and the nuclei of these cells are centrally located. As the seminal vesicles do not shrink during this period, it is very likely that the vesicular fluid is replenished.

The seminal vesicles during October are

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in the same condition as in the previous month (Table I). The seminal vesicles appear quite prominent. Some of the cavities towards the center of the vesicles are shrunk and appear empty, while the peripheral ones

vesicles and the vesicular lumina attain their maximum size. It is during this period that some of the cavities appear empty, thereby indicating the extrusion of the vesicular fluid.

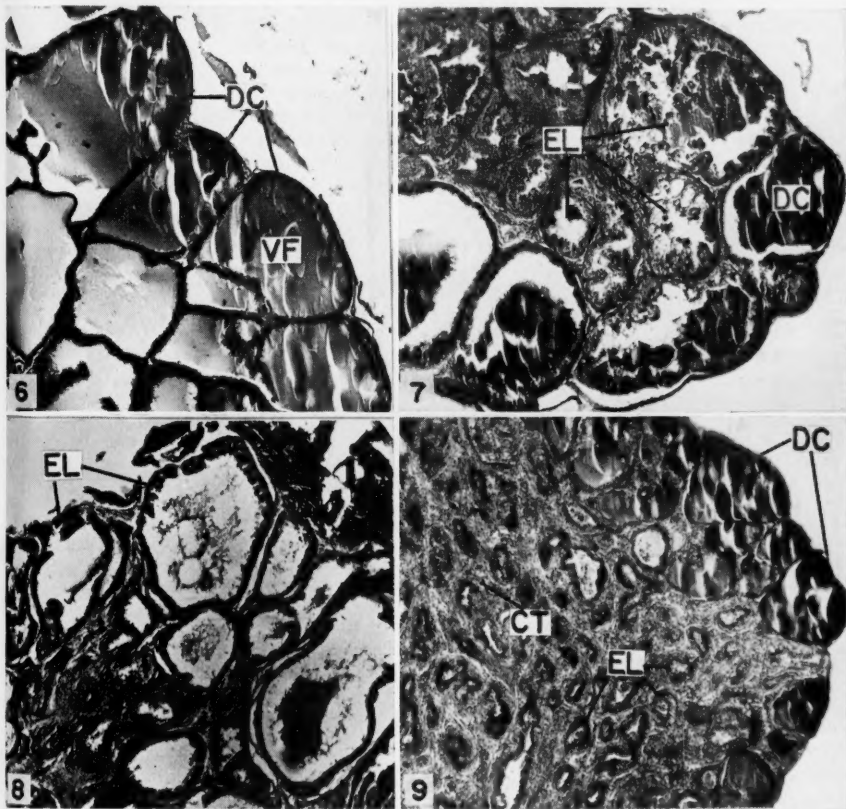


Fig. 6. Transverse section through the seminal vesicle of *Heteropneustes* collected in August. Note the large sized locules distended with the vesicular fluid. Bouin: Ehrlich's hematoxylin  $\times 65$ .

Fig. 7. Transverse section through the seminal vesicle of *Heteropneustes* collected in September. Note the empty locules. Bouin: Ehrlich's hematoxylin  $\times 65$ .

Fig. 8. Transverse section through the seminal vesicles of *Heteropneustes* collected in October. Note the presence of a large number of empty locules. Bouin: Ehrlich's hematoxylin  $\times 60$ .

Fig. 9. Transverse section through the seminal vesicle of *Heteropneustes* collected in January. Most of the locules are shrunk and those distended with the fluid are fewer and are peripherally disposed. Note the thick connective tissue separating and surrounding the shrunk locules. Bouin: Ehrlich's hematoxylin  $\times 60$ .

are distended with the fluid. During this month also the vesicular fluid appears to have been extruded as a constituent of milt. This is evidenced by the presence of a large number of empty locules (Fig. 8, el). The secretory epithelium in the empty locules is columnar.

During the spawning period the seminal

#### c. Postspawning period:

During November, the seminal vesicles have slightly decreased in size (Table I) but are still prominent. All the vesicular cavities excepting a few are filled with the fluid. The empty locules are centrally located, while those distended with the fluid

are peripherally disposed. The average diameter of the vesicular lumina indicates a decrease (Table I).

The average length of the seminal vesicles during December is the same as in the previous month (Table I). All the locules are uniformly filled with the vesicular fluid. The average width of the vesicular lumina indicates a decrease (Table I).

During January, the average length and width of the seminal vesicles and vesicular lumina respectively indicate appreciable decrease (Table I). Majority of the cavities are empty (Fig. 9, el) and those that are

empty cavities appear to have increased in number (Fig. 10, el).

The seminal vesicles indicate a striking reduction in their average length during March (Table I). They are hardly recognizable from the lobes of the testes. They no longer have the characteristic yellow color. All the vesicular cavities are considerably shrunken (Fig. 11, el), and their average width is 0.104 mm (Table I). The cavities are separated and surrounded by thick partitions of connective tissue sheaths (Fig. 11, ct). The secretory epithelium is columnar and their nuclei are basally located. A few

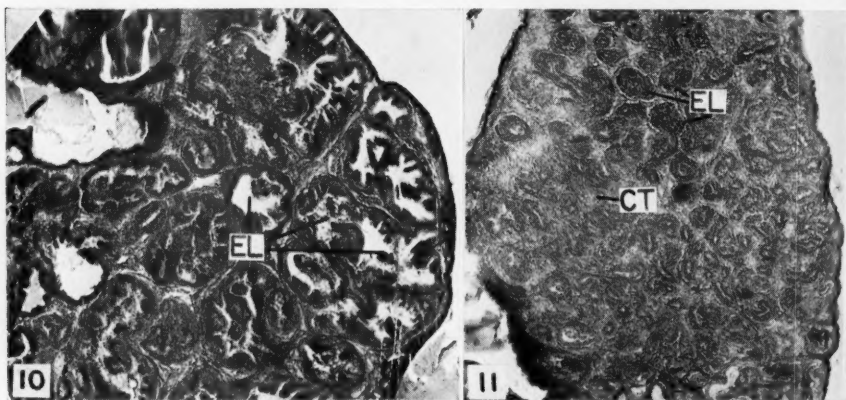


Fig. 10. Transverse section through the seminal vesicle of *Heteropneustes* collected in February. Most of the locules are shrunken and empty. Bouin: Ehrlich's hematoxylin  $\times 60$ .

Fig. 11. Transverse section through the seminal vesicle of *Heteropneustes* collected in March. All the locules are shrunken considerably and the connective tissue separating the locules is thicker. Bouin: Ehrlich's hematoxylin  $\times 60$ .

distended with the fluid (Fig. 9, dc) are fewer and are peripherally disposed. The connective tissue sheath separating the cavities has become thick (Fig. 9, ct).

During the postspawning period the seminal vesicles gradually start regressing. Empty locules or cavities are also noticed in large numbers only in the late postspawning period (January). Possibly, the vesicular fluid is either thrown out or absorbed. Otherwise it is difficult to account for the presence of empty cavities in the late postspawning period.

#### d. Preparatory period:

This period comprises the months of February, March and April.

During February, the seminal vesicles do not indicate any marked change in their external appearance. Towards the center the

cavities filled with the vesicular fluid are, however, present towards the periphery.

During April, the seminal vesicles completely regress and become almost indistinguishable from the testicular lobes (Fig. 13). The average length is 4.6 mm (Table I). The average width of the vesicular lumina is least during this period (Table I). All the cavities are uniformly empty and their epithelium is columnar (Fig. 12). One or two cavities filled with the vesicular fluid are also present.

During the preparatory period, the seminal vesicles completely regress and they become almost like the testicular lobes. They lose their characteristic color. All the cavities remain empty and these are filled with the fluid only in the succeeding prespawning period.

### 3. Observations

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### 3. Observations on the vesicular fluid:

The true function of the vesicular fluid is unknown. Different authors have ascribed a variety of functions to this fluid. Weisel (1948) stated that the spermatozoa of *Gillichthys* are inactive in the vesicular fluid, and live as long in sea water as in sea water with vesicular fluid added. He also reported that solutions of sodium chloride, potassium chloride, magnesium chloride and calcium chloride activate the spermatozoa lying dormant in a drop of vesicular fluid. Ellis and Jones (1939) and Weisel (1949) stated that the activation is caused by changes in osmotic pressure. The spermatozoa in the highly viscous vesicular fluid of *Heteropneustes* are inactive, but become active when a drop of Holtfreter solution is added. It is also noticed that spermatozoa of *Heteropneustes* become immobilized within a minute in tap water, but they remain active for slightly longer time in tank water. In Holtfreter solution the spermatozoa remain highly motile for more than an hour and the sperms are not so active in ordinary saline solution (Ramaswami and Sundararaj, 1957). It is very likely that calcium ions in the Holtfreter solution are responsible for the prolonged activity of the sperms. Yanagimachi and Kanoh (1953) have stated that the spermatozoa of *Clupea* become highly motile on contact with the egg surface in the presence of calcium ions. Eggs of *Heteropneustes* have been fertilized with considerable success in the laboratory using testis squash with and without the seminal vesicles. This clearly indicates that the seminal vesicular fluid is not necessary for the artificial fertilization of eggs. The vesicular fluid probably helps in fertilization in natural habitats. The fluid also appears to keep what little spermatozoa they have in an inactive but viable condition.

### DISCUSSION

Weisel (1949) stated that the seminal vesicles of *Gillichthys* react negatively to androgens. Hence, he concluded that the seminal vesicles of *Gillichthys* are in no way a part of the Wolffian duct. Obviously, these are not homologous with their reptilian and mammalian counterparts. The same appears to be true of *Heteropneustes* also. Evidently, the seminal vesicles are specialized lobes of the testes meant for purposes of secretion.

The seminal vesicles of *Gillichthys* do not



Fig. 12. Transverse section through the seminal vesicle of *Heteropneustes* collected in April. All the locules are uniformly empty. Bouin: Ehrlich's hematoxylin  $\times 60$ .

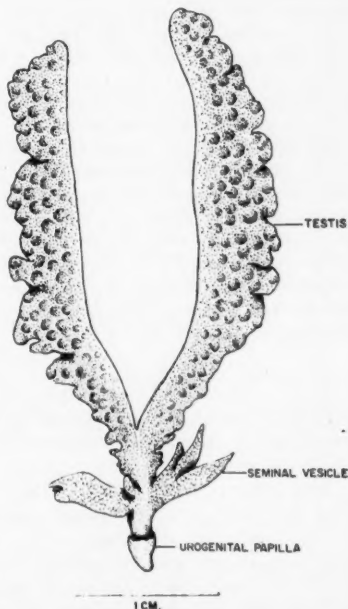


Fig. 13. Figure showing the testes and the seminal vesicles of *Heteropneustes* in April. The seminal vesicles have regressed and are very small in size.

exhibit seasonal changes (Weisel, 1949). But in *Heteropneustes* the seminal vesicles exhibit remarkable seasonal changes which closely follow that of the testis (Sundararaj, 1958). During the prespawning period, they increase in size and simultaneously accumulate the vesicular fluid. They attain their maximum size during the spawning season. It is during this season that the vesicular fluid is extruded as a constituent of milt. The males of *Heteropneustes* yield negligibly small quantities of milt even at the height of breeding season. It is very likely that the fluid of the seminal vesicles serves as a medium for the sperms. During the postspawning and preparatory periods the seminal vesicles gradually become small in size. The vesicular cavities also rapidly decrease in size. The fluid is either absorbed or thrown out. This apparently has no relation with spawning. The gradual regression of the seminal vesicles in the postspawning and preparatory periods indicates that the seminal vesicles function during the breeding season, when the fluid is expelled as a constituent of milt.

The presence of well developed seminal vesicles in *Heteropneustes* may probably be related to the small size of the testes. In the Pacific salmon which does not possess a well developed seminal vesicle, the epithelial lining of the spermatid ducts is similar to that noticed in the seminal vesicles of *Gillichthys* (Weisel, 1949). Thus if the testes are large, the seminal vesicles may be absent. It has been determined by actual fertilization tests in *Heteropneustes* that only a small piece of the testis need be used to fertilize a large number of eggs. It is quite possible that the vesicular fluid has some action by which the period of viability of the sperms is lengthened.

#### SUMMARY

1. *Heteropneustes fossilis* has well developed seminal vesicles which are specialized lobes of the testes.

2. The seminal vesicles do not act as storage for the sperms, excepting a small quantity noticed at the place where the seminal vesicles communicate with the testis.

3. The seminal vesicles secrete the vesicular fluid and the actual function of the fluid is not known.

4. The seminal vesicles exhibit seasonal changes which closely correspond with that

of testes. They increase in size during the prespawning period and attain the maximum size during the spawning period. The fluid is probably expelled mainly as a constituent of milt during spawning. The vesicles start regression during the postspawning period and become almost indistinguishable from the lobes of the testes during the preparatory period.

#### ACKNOWLEDGMENTS

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## *Notropis saladonis*, a New Cyprinid Fish Endemic in the Río Salado of Northeastern México<sup>1</sup>

CARL L. HUBBS AND CLARK HUBBS

THE small minnow described below adds one more element of northern affinity to the predominantly Nearctic fauna of northeastern México. It was discovered during a review of the extensive material that Luciano Val Guerra collected in June 1951, during his fish-faunal survey of the Río Salado System (Guerra's material, as well as his M.A. thesis, "Ichthyological Survey of the Río Salado, México," is deposited in The University of Texas). Two additional series were subsequently located in collections made by Seth Eugene Meek and by E. G. Marsh, Jr. (deposited, respectively, in the Chicago Natural History Museum and the University of Michigan Museum of Zoology). For the opportunity of studying and reporting on this ichthyological discovery we are grateful to the collectors of the material and to the curators of the museums in which the specimens are stored.

Counts and measurements have been made in accordance with the criteria set forth by Hubbs and Lagler (1947: 8-15, figs. 2-5).

### THE SALADO SHINER

#### *Notropis saladonis*, sp. nov.

Fig. 1, Maps 1-2

**Material.**—The 101 type specimens range in standard length from 15 to 38 mm. and are from 11 localities, all along the course of the Río Salado and one of its two main headwaters, Río Sabinas de Coahuila, in the Río Grande drainage basin of the states of Nuevo León and Coahuila, México (Map 1). The material is deposited in several museums, as follows: Chicago Natural History

Museum (CNHM), Escuela Nacional de Ciencias Biológicas de México (ENCB), Natural History Museum of Stanford University (SU), (The University of) Texas Natural History Collection (TNHC), University of Michigan Museum of Zoology (UMMZ), and the United States National Museum (USNM).

The holotype, UMMZ 173132, an adult male 32 mm. in standard length, was collected by Luciano Val Guerra in Río Salado, 1 mile west of Manuel Martínez Pareda and 10 miles south of Anahuac, Nuevo León, on June 11, 1951. The location is No. 7 on Map 2.

The paratypes are from 11 collecting stations, which are numbered in sequence upstream, on Map 2, and in the following list:

(1) Río Salado, 2 miles south of La Gloria, Nuevo León: collected by Guerra on June 8, 1951 (6 adults, 21-28 mm. in standard length, SU 50173).

(2) Río Salado, 2 miles northeast of the bridge on the Pan-American (Laredo-Monterrey) Highway: collected by Guerra on June 9, 1951 (11 adults, 22-29 mm., CNHM 62160).

(3) Río Salado, on the González Hacienda, 25 miles by road north-northeast of La Gloria, Nuevo León: collected by Guerra on June 9, 1951 (31 specimens, 16-32 mm., ENCB—).

(4) Río Salado, on the González Hacienda, 1.5 miles southeast of the water pump, Nuevo León: collected by Guerra on June 9, 1951 (12 specimens, 17-31 mm., USNM 175276).

(5) Río Salado, on the González Hacienda, 3 miles south-southeast of the water pump, Nuevo León: collected by Guerra on June

<sup>1</sup> Contributions from the Scripps Institution of Oceanography, New Series, and from The University of Texas.



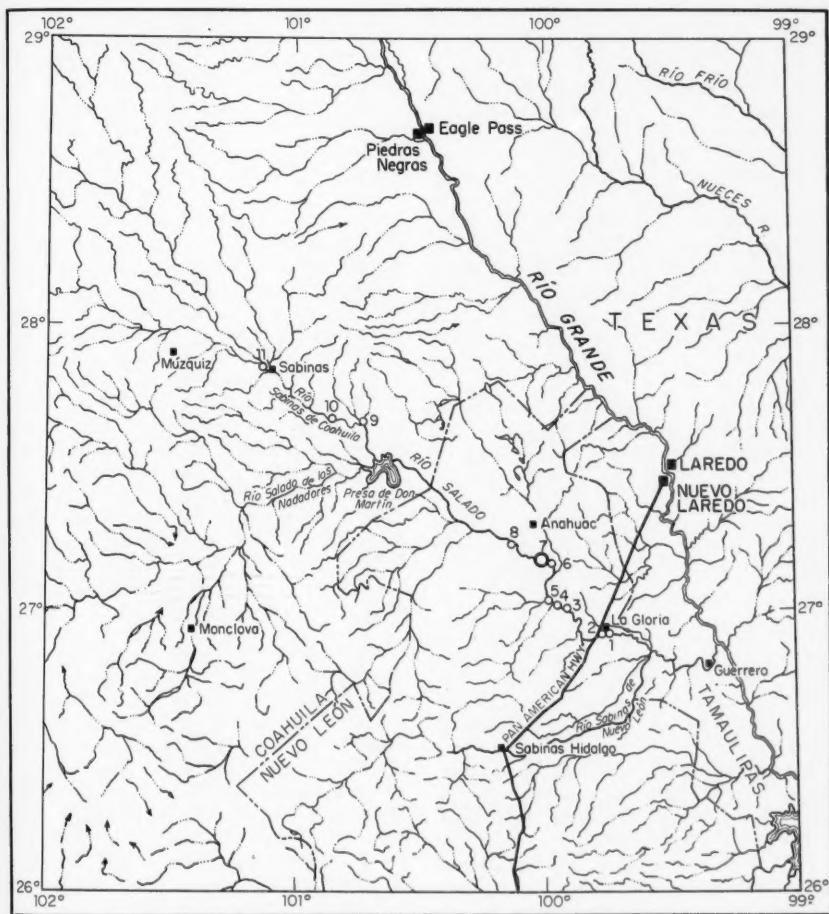




## DIAGNOSIS

*Notropis saladonis* may be distinguished from each of the multitudinous species of *Notropis*, as this complex is currently constituted, by a distinctive combination of

11 to 16 before dorsal (10 to 13 rows). The anterior lateral line scales are weakly elevated; those in contact with the shoulder girdle, often markedly so. Very few and only the anteriormost have exposed fields as much as twice as high as long. The posterior



Map. 2. Río Salado, with record stations for the types of *Notropis saladonis*, numbered as listed in the text. The type-locality is No. 7.

characters. It is a small species (maximum standard length, 38 mm.), with delicate texture, very thin scales, and slender fin rays. The principal anal rays number 8, rarely 7. The pharyngeal teeth number 4-4 (rarely 3 in one row). The scales are relatively large: usually 32 along the lateral line, 20 to 24 in greatest body circumference, and

borders of the lateral line scales are not emarginate. The lateral line is moderately decurved, rising to contact the lateral band behind the dorsal fin. The infraorbital canal is complete, or, rarely, narrowly interrupted. The body is moderately deep and rather strongly compressed: the width is less than half the depth. The head is rather deep:



sexual dimorphism in form and color. It has unusually strong nuptial tubercles over the top of the head and over the snout. *N. ornatus* inhabits the Río Conchos division of Río Grande drainage basin and drainages with supposedly derived faunas to the west and south thereof.

*N. saladonis* has been compared also with the several species, in part undescribed, that inhabit the east-coast streams of México south of the Río Grande, and has been found to differ adequately from all of them. No other endemic Mexican species are close.

Perhaps the closest affinities of *N. saladonis* lie with *N. volucellus* (Cope) and *N. buchanani* Meek. A discussion of its possible kinship with those species involves a consideration of their relationship to one another. The senior author long regarded *buchanani* as a subspecies of *volucellus* (see Hubbs and Greene, 1928: 377-9). This view was followed by Trautman (1931) in his description of the big-river subspecies, *N. v. wickliffi*. More recently, however, thanks to a critical study by W. Ralph Taylor, it has developed that *buchanani* is a fully distinct species. Diagnostic characters have been stated by Bailey (1951: 222-3; 1956: 363) and by Trautman (1957: 93, 380-7, figs. 91-3). A study of the Mexican and Texas representatives of the combined group has convinced the authors of the validity of the specific separation. A further difference lies in the nuptial tubercles, which in *N. buchanani* we find to be confined on the head to the dorsal surface, whereas in *N. volucellus* they cover the snout and occur on the mandible and cheek. Furthermore, the dermal sense organs, as viewed under moderate magnification, are much more conspicuous in *N. buchanani* than in *N. volucellus* (presumably as an adaptation to living in more turbid waters). The supposed partial intergradation between *buchanani* and *volucellus* is not confirmed.

In many respects *N. saladonis* closely resembles *N. buchanani* and it agrees with that species in some of the features by which it is differentiated from *N. volucellus*. The compression of the body is one such character. So also is the enlargement and isolation of the melanophores, which is particularly notable in the far-southwestern populations of *N. buchanani* (see paragraph below). *N. saladonis* and *N. buchanani* further and distinctively agree in their very small size, fragile appearance, extremely pale general color, slender fin rays, similar meris-

tic counts, and the restriction of the nuptial tubercles of the head to the dorsal surface. However, *N. saladonis* is clearly distinct from *N. buchanani*. *Notropis buchanani* differs from the Salado endemic in the almost invariable lack and at most incomplete development of the infraorbital canal, in having the anterior lateral line scales typically 3 to 5 times as high as long on the exposed fields, and in having the posterior border of these scales emarginate by the pores. The sense organs on the head, particularly on the cheek, are especially obvious, and a vertical row of sensory papillae is conspicuous under moderate magnification along the base of the exposed surface of the lateral-line scales. The nuptial tubercles on the top of the head are more enlarged (in relative size). The fins are all more elevated, more acute, and more falcate (the pelvic fin typically far overlaps the front of the anal base). The mouth is somewhat more oblique (at least in the Mexican representatives), rising to level with the bottom of the pupil. Pigment is massed to form a wedge in front of the dorsal fin and before the rudimentary caudal rays above and below, and there is more pigment along the bases of the dorsal and anal fins. In the better-pigmented specimens there is a greater tendency toward the black bordering of the lateral-line pores. One or two rows of black specks or dashes are more or less completely developed along the lower border of the caudal peduncle, and the peritroct is more or less blackened.

The better-pigmented specimens of *buchanani*, from the San Juan and Salado river systems in México, and from the Bosque River at Caldwell Crossing, near China Springs, McLennan County, Texas (UMMZ 92112), have very conspicuous giant melanophores, a rather definite dark lateral band, and the pigment in general unusually well-developed for this species. Other specimens from Mexico are very pale, but their paleness is due in part at least to the adherence of the melanophores to the lost scales. Subspeciation within *N. buchanani* may well be demonstrated, but will not affect the specific separation of *N. saladonis*. The two species live together in the Río Salado System and remain distinct. The collection from the Río Sabinas de Coahuila at Rancho de los Borregos, locality 9 in the list of specimens on page 298, includes, in addition to the 5 adults of *N. saladonis*, 38 specimens of *N. buchanani* and 1 hybrid

between the two species. But within the North American cyprinids such sporadic hybridization is not interpretable as evidence for conspecificity, nor even for close relationship (Hubbs, 1955: 7-10, figs. 2-3). From northeastern México *N. buchanani* ranges northward to the upper Mississippi and Ohio rivers.

*N. saladonis* also closely resembles *N. volucellus* (Cope), as that species is now constituted, and the two may be genetically akin. Points of resemblance include the tooth formula, the same ray counts, and the similar scale counts. The slight elevation of anteriormost lateral line scales approaches a diagnostic feature of *N. volucellus*. In size and texture the Salado shiner also approaches the mimic shiner. But there are many valid and consistent differences that hold not only in general, but also when *N. saladonis* is compared with the race of *N. volucellus*, namely *N. v. nocomis* (Jordan and Gilbert), that occurs nearest to the Río Salado. The contrasting characters of *N. volucellus* (all subspecies considered) are as follows: The size is larger, with the maximum standard length at any locality consistently greater than 40 mm., and the texture is less delicate. The scales are slightly more numerous, 33 to 38, in the lateral line. The anterior lateral-line scales are distinctly more elevated, having exposed fields about 2 to 4 times as high as long (varying with the subspecies); and the posterior borders of these elevated scales are more or less strongly emarginate beside the pores. The lateral line is little decurved anteriorly, and is either in contact with the lateral band throughout its length or is narrowly separated anteriorly, with a junction below the middle of the dorsal-fin base. The body is more terete, definitely thicker (the greatest width is more than half the greatest depth). The head is rather slender and is thicker (the depth steps 1.4 to 1.6 in the length and is only about one-fourth greater than the head width); and the interorbital and interanarial areas are only slightly convex. The upper lip is usually somewhat overhung by the snout and usually rises only to about level with the lower border of the orbit. The general color tone is darker (least so in *N. v. wickliffi*), and the small melanophores are usually in contact, to give a more even, less-speckled shade. Pigment is more or less notably massed to form wedges in front of the dorsal origin and just before the rudimentary caudal rays, above and

below; and is also concentrated, more or less, near the middle of the bases of the dorsal and anal fins; the middorsal stripe is more evident, even behind the dorsal fin. Pigment is more concentrated at the upper and lower borders of the lateral-line pores. There is a fairly strong, essentially biserial streak along the lower border of the caudal peduncle, and the peritroct is considerably blackened (except, perhaps, in *N. v. wickliffi*), though the pigment may be deeplying and externally inconspicuous. The nuptial tubercles are moderately strong and extend completely over the snout, with no reduction, or even with some strengthening; some occur on the outer side of each mandible and others on the cheeks, with some strengthening ventrally. Sensory papillae are apparent (though not so strongly as in *N. buchanani*) in a vertical row along the base of the exposed field of each of the anterior lateral-line scales. *N. volucellus* ranges from southern Canada to the Guadalupe River system in central Texas, and has not been taken in or very close to México. Trautman (1957: 381, map 91) erred in extending the range into México (he did express doubt as to the status and distributional limits of the southwestern representatives).

In the possibly natural group comprising the species *saladonis*, *buchanani*, and *volucellus*, it will be seen, from the discussions just given, that the characters are often and variously paired, in the three comparisons between these forms.

#### DESCRIPTION

*Size and Texture.*—This is a very small species, not known to exceed 38 mm. in standard length (see pp. 297-8); and it is of very delicate skin texture.

*Body Form.*—The body is moderately deep (for proportions, see Table II)—on the average somewhat deeper in females than in males. The dorsal and ventral contours are almost equally and almost symmetrically curved. The form is more compressed than in most shiners of this general type: the greatest width is definitely less than half the maximum depth. The dorsal contour is highest and is slightly angulated at the origin of the dorsal fin. The predorsal contour is weakly arched to the occiput. The dorsal and anal bases are somewhat oblique. The contours of the caudal peduncle converge gently in nearly straight lines, to a point barely in advance of the anteriormost

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caudal rays. The preanal contour is rather evenly curved forward to the isthmus, in a weak curve in the young and in males and in a broad curve in females. The lowest point of the contour is about three-fourths of the distance between pectoral base and pelvic base. Various body proportions are given in Table II.

**Head Form.**—In side view the head is roughly triangular, with the rostral angle narrowly rounded and with the axis a little below the middle. In top view the short muzzle is broadly U-shaped. The dorsal contour is broadly arched from tip of snout to above front of orbit, thence weakly arched to occiput. The ventral contour is gently and evenly curved. The head is relatively deep: the greatest depth, from the occiput to the isthmus, is about one-third greater than the maximum width of the head and steps 1.3 to 1.4 times into the head length (including the opercular membrane). The flattish sides of the head are subvertical. In the anterior view the interorbital and internarial regions are moderately convex, more so than in most similar species (this character shows in the figure of the female, but not in that of the male, because the head of the male, as figured, is twisted out of plane). The center of the eye is distinctly nearer to the tip of the snout than to the opercular margin. The eye is longer than the snout, and its length somewhat exceeds the bony interorbital width.

**Mouth.**—The mouth is moderately oblique. The premaxillary rises in a gentle curve to approximately level with the midpoint between the lower margins of pupil and orbit. The front of the upper lip is about even with the front of the snout and is never markedly overhung. The lower lip is definitely included. The upper jaw reaches variably to any point between the verticals from the anterior margins of the eye and of the pupil. Its length averages more than that of the snout but less than that of the orbit (Table II). Viewed from below the gape is U-shaped, with the separated rami either parallel or divergent. The isthmus is narrow. Various head proportions are given in Table II.

**Pharyngeal Arch and Teeth.**—The tooth-bearing lower pharyngeal arch is J-shaped. The tip of the short upper arm is pointed anteriorly. The lower arm abruptly narrows and straightens between the second and the third tooth, and again widens just above the bluntly pointed tip. The margin is abruptly

angulated where the arch begins to narrow. The teeth are confined to the main row and normally number 4 on each side. In 39 specimens the formula is 4-4 in 36 and 4-3 in 3. The individual teeth are 2.5 to 4.0 times as long as broad. The hooked tips overhang the weakly-developed, entire grinding surfaces. There is no space for a tooth to develop in the lesser row. The equally long upper two teeth are longer

TABLE I  
MERISTIC COUNTS ON TYPES OF *Notropis saladonis*  
In the frequency column the count on the holotype is italicized.

Fin rays	Mean	Frequencies
Dorsal	7.99	7 (1), 8 (90)
Anal	7.84	7 (14), 8 (74)
Pelvic	7.84	7 (15), 8 (82)
Pectoral	14.11	13 (9), 14 (63), 15 (20)
Caudal	18.90	14 (1) . . . 18 (1), 19 (58), 20 (1)
Scale counts		
Lateral line	32.03	31 (9), 32 (46), 33 (9), 34 (1)
Above lateral line	4.98	4 (3), 5 (44), 6 (2)
Below lateral line	3.26	3 (61), 4 (21)
Lateral line to pelvic	3.19	3 (58), 4 (14)
Body circumference	23.09	20 (1) . . . 22 (26), 23 (10), 24 (23), 25 (35) . . . 27 (1)
Circumference, above	11.00	9 (1), 10 (2), 11 (41), 12 (2), 13 (1)
Circumference, below	11.66	9 (9), 10 (12), 11 (39), 12 (5), 13 (1)
Caudal peduncle	12.02	12 (51), 13 (1)
C. peduncle, above	5.00	5 (52)
C. peduncle, below	5.02	5 (55), 6 (1)
Scales before dorsal	13.20	11 (3), 12 (17), 13 (11), 14 (17), 15 (7), 16 (1)
Rows before dorsal	11.92	11 (17), 12 (33), 13 (12)

than the lower two, and have narrower bases and more strongly hooked tips.

**Intestine.**—The intestine retains the simple compressed S-shape characteristic of the species still retained in *Notropis*.

**Scales.**—Over most of the body the squamation is complete and rather regular (for counts, see Table I). The squamation of the breast is variably reduced: the region from between the pectoral fins to the isthmus may be scaleless, provided with scattered scales, or completely scaled. The scales in the predorsal region are often somewhat irregular in arrangement and are slightly reduced in size. Everywhere the scales are



extremely thin and delicate. On the sides of the body the exposed fields slightly approach a diamond shape, with the vertical axis somewhat greater than the longitudinal. Posteriorly the lateral-line scales are scarcely modified in shape, but toward the head they are weakly elevated (though less so than in *N. volucellus*); except on the two scales in contact with the shoulder girdle, and occasionally one or two immediately following, the exposed fields remain less than twice as

base. On the urosome it is essentially straight and gradually ascends to the middle of the band. The supratemporal canal is either short, with one terminal pore, or is of moderate length, with a terminal and a median pore. The supraorbital canal extends from just behind the posterior orbital rim to the anterior nostril. Its second pore is on a side canal. The infraorbital canal generally appears complete; it is complete in 9 of 10 specimens minutely examined,

TABLE II

PROPORTIONAL MEASUREMENTS OF ADULT TYPES OF *Notropis saladonis*

All proportions are expressed in thousandths of the standard length. Only larger specimens were measured. Not more than 5 of either sex were measured from a given locality.

Holotype	Males			Females		
	Mean	Range	Number	Mean	Range	Number
Standard length..... 32.1	28.0	26.1-32.1	18	29.1	27.6-33.4	22
Body depth..... 271	267	247-282	18	285	266-306	22
Caudal peduncle depth..... 128	125	120-134	18	120	108-124	22
Caudal peduncle length..... 246	226	206-246	18	218	207-232	22
Head length..... 277	280	272-291	18	282	269-293	22
Head depth..... 187	199	187-212	18	200	192-206	22
Head width..... 156	148	142-156	18	148	138-156	22
Snout length..... 81	80	73-85	18	78	70-89	22
Orbit length..... 93	99	89-105	18	99	87-105	22
Upper jaw length..... 87	88	80-93	18	89	81-100	22
Suborbital width..... 31	31	25-36	18	30	26-35	22
Least bony interorbital..... 81	79	73-90	18	76	71-84	22
Predorsal length..... 520	519	505-547	18	520	494-546	22
Length of depressed dorsal fin..... 252	259	240-268	13	251	237-264	14
Pectoral fin length..... 221	216	204-230	16	205	195-237	17
Dorsal origin to lateral line..... 190	176	167-190	17	175	158-192	19
Pelvic insertion to lateral line... 97	99	89-115	17	116	89-132	16
Width of upper lip..... 12	11	7-14	18	11	7-14	21
Overall width of mouth, including lips..... 69	70	63-79	18	69	64-78	22

high as long. All scales, including those of the lateral line anteriorly, have the posterior border rounded, without marked emargination. On each scale the radii on the posterior field span about one-third of the scale margin. The number of radii varies with the size of the scale; 6 to 8 extend from near the focus.

**Lateral Line.**—The lateral line of the body is complete. Anteriorly it is moderately curved, almost following the ventral profile. For this reason it curves below the lateral band from above the end of the pectoral base to behind the dorsal fin, striking the band again at some point above the anal

and in all 10 extends to below the anterior nostril. The one specimen with the canal incomplete has a short break on each side—on the posterior rim of the orbit on the left side, and at the bend near the dorsal margin of the orbit on the right. The complete preoperculummandibular canal extends from above the middle of the gape to about the level of the ventral rim of the orbit.

**Sensory Papillae.**—The sensory papillae on the cheek and other parts of the head are inconspicuous under ordinary magnifications of the wide-field microscope, and we fail to detect the papillae that form a vertical row

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along the base of the exposed field of the anterior lateral-line scales in certain species, notably *N. volucellus*. There is no trace of a barbel.

**Nuptial Tubercles.**—Breeding males (and, occasionally, to a very slight degree, large females) develop nuptial tubercles on the head and on the pectoral fin. Those on the head are confined to the dorsal surface and become scarce to absent over the heart-shaped parietal blotch, and become weak on the snout. They do not reach the mouth and are lacking on the mandible, cheeks, and opercular regions. Those on the top of the head are relatively small and are scattered. As usual, nuptial tubercles are de-

veloped on the upper surface of the second to the seventh or eighth pectoral ray (but not on the other fins). The individual organs are rather small, and are pointed but not definitely hooked. On each ray they start near the base in a single file, which soon branches. Near the middle of the tuberculate area the tubercles tend to form 3 irregular rows, with about 4 organs in each file per segment of ray.

**Fins.**—The fragile, slender-rayed, round-tipped, nonfalcate fins are of moderate size, and, for shiners of this type, of rather usual location (for measurements of dorsal and pectoral, and for predorsal and postanal lengths, see Table II). The dorsal originates slightly in advance of the pelvic. Its depressed length is about half the predorsal length in males, usually somewhat less in

females. The anal originates behind the end of the dorsal base. Its depressed length approximates the length of the dorsal fin to the tip of the last ray. When the dorsal and anal fins are elevated, the distal borders are almost straight; when these fins are depressed, the anterior rays extend beyond the posterior rays. The caudal fin is strongly forked: the shortest middle ray is less than half as long as the longer lobe. The posterior margins of the pectoral and pelvic are straight to gently rounded. The pectoral does not reach the pelvic, and the pelvic usually does not reach the anal origin, and never extends far beyond. Ray counts are tallied in Table I.



Fig. 1. Type specimens of *Notropis saladonis*. Above, holotype; below, female paratype from same collection.

the decurved part of the lateral line, just above and below the pores, or even just below the anterior part of the sensory line. Otherwise the lower sides are devoid of melanophores. The speckling is most prominent along the lateral band, which is narrower than the pupil posteriorly and rather diffuse on the trunk. The stripe is composed of large individual melanophores that seldom contact, and appear discrete to the unaided eye. The stripe ends at or just before the hypural crease, beyond which a pale area precedes the small basicaudal spot, which tends to be irregularly wedge-shaped and is constituted by only a few of the large discrete melanophores. The inner caudal rays have dark dashes along either edge, but these are hardly apparent without magnification. Anteriorly the lateral band is represented across the opercle by a few melanophores behind the upper preopercular margin. In a few specimens some melanophores are scattered on the upper cheek. Usually there is a faint row on the extreme lower edge of the orbit, and commonly a few specks on the sides of the snout, but never in a definite band around the muzzle. In some specimens a few melanophores occur on the lips, and usually an inconspicuous patch of pigment crosses the tip of the chin, but otherwise the ventral part of the head is unpigmented.

The dorsal pigmentation consists of a row of fine melanophores bordering each scale pocket, with color cells occasionally more or less enlarged to give the dorsum as well as the lateral band a speckled appearance. On the trunk this pigment pattern is continued, faintly, on the light stripe above the lateral band. The dark pigment is not particularly concentrated in a wedge in the front of the dorsal origin or in front of the rudimentary caudal rays, either above or below, nor just behind the occiput. The middorsal streak anterior to the dorsal fin consists of a faint median and a pair of lateral rows of scattered melanophores. There is some pigment, but not a pronounced dash, along the middle of the dorsal fin base. A few melanophores may flank the posterior dorsal rays, but behind the fin the middorsal streak is either absent, or consists of a pair of faint rows of scattered melanophores, which become more distinct posteriorly. The dorsal fin, like the caudal, but unlike the other fins, has fine dashed lines along the edges of the rays.

Small and inconspicuous melanophores

are usually scattered along the anal-fin base, and in a few specimens a few minute scattered specks, at most, represent the stripe that is developed in most species along the lower border of the caudal peduncle. Otherwise the ventral regions are devoid of pigment.

The heart-shaped parietal blotch is uniformly darkened. Deep-lying pigment in the interorbital region is overlain by scattered melanophores, which extend onto the snout between the nostrils.

The peritoneum has scattered melanophores.

#### DISTRIBUTION AND ECOLOGY

*Notropis saladonis* is apparently endemic to the Río Salado System (Map 1) and is the only species that we have found to be confined to this system. One other, *Notropis rutilus* (Girard), seems to be confined to Río Salado and Río San Juan divisions of the Río Grande System; it is a member of the *N. proserpinus* (Girard) complex, which consists of several allopatric representatives. That *N. saladonis* is restricted to the Río Salado System seems highly probable, for since 1930 the fish fauna of northeastern México has been under scrutiny (Hubbs and Gordon, MS) and numerous collections have been obtained and studied from the Río Grande proper, from its three tributary systems of consequence in México (those of the ríos San Juan, Salado, and Conchos), and from the tributaries of the Río Grande in Texas, New Mexico, and Colorado.

Within the Río Salado System the species is characteristic of, and, so far as now known, is restricted to, the main course of the river plus its upstream continuation, Río Sabinas de Coahuila (Map 2). The considerable number of collections and of specimens indicate that the species is definitely characteristic of this stream. It has not appeared in the collections from the lower tributary, Río Sabinas de Nuevo León, nor from the upper tributary, Río Salado de los Nadales. In recent years, as in 1951, when Luciano Val Guerra conducted an extensive ichthyological survey in the drainage basin, the other tributaries have been almost entirely dry, and the main stream has been much reduced in flow. The fish fauna, however, including as it does such species as *Cycleptus elongatus* (LeSueur) and *Pylodictis olivaris* (Rafinesque) is suggestive of the biota of a fairly large stream. The appearance of *N. saladonis* suggests an inhabitant of rather

large, slow-moving streams, indicating a preference for living in turbid water over bedrock silt. It is found in headwater

The collection contains 15 males and 7 females. The June collection and in this species is of the year. mm. long. The specimens in this spring.

Both males and females are mature. The collection consists of 1951, the males and females are 1907, 6 females. The decurved part of the lateral line is from the largest specimen, 18 males and 28 females.

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large, slow, and silty streams, and its form indicates mid-water swimming habits. According to the collection records, this species lives in waters with little vegetation, in turbid to clear waters flowing slowly over bedrock that is covered by mud and sandy silt. It appears to avoid clear spring-fed headwaters.

#### REPRODUCTION

The collections taken from June 8 to 15 contain nuptial males and gravid females, and the specimens collected on April 7 were approaching full maturity. Three of the June collections also contain young fish, and in view of the very small size of the species it is assumed that they were young-of-the-year. Two June females, 23 and 24 mm. long, are not ripe. From these observations it is inferred that this shiner reproduces in spring and early summer.

Both sexes spawn at a small size. Nuptial males are 19 to 34 mm. in standard length; mature females, 21 to 38 mm. long. In the collections of April, 1939, and of June, 1951, the maximum sizes of males and females are 32 and 33 mm., respectively, whereas in the series of 7 taken in 1906 or 1907, the male is 34 mm. long and the 6 females are 29 to 38 mm. long. Possibly the decreased stream flow has led to a further dwarfing of the species. In the 3 series from the Río Sabinas de Coahuila the largest specimen is only 29 mm. long. The 18 males measured for Table II averaged 28 mm.; the 22 females, 29 mm. There

seems to be little sexual dimorphism, even in size.

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## Status of the Nominal Cyprinid Species *Moniana deliciosa* Girard and *Cyprinella texana* Girard

Aided by NSF G-3882

ROYAL D. SUTTKUS

DURING the past ten years an intensive field study has been made of southern cyprinid fishes. Material has been accumulated in the fish collection of Tulane University and numerous series and "types" in the older collections have been studied. Certain difficulties are found in studying the species of *Notropis*, a very large genus, and other small cyprinids. Critical study has shown that with most small species of cyprinids and especially with *Notropis* that

the minute details of pigmentation are excellent characters and when a study of these is combined with fin ray, scale and pharyngeal teeth counts, the identification of the species is possible. Results of these studies, including descriptions of new species, have been embodied in a series of recent papers by Bailey and Suttus (1952), Suttus and Raney (1955a, b, c) and Suttus (1955). Other similar studies are in press and preparation. The failure of some early workers

to correctly or completely sort the series with which they were working at the time original descriptions were written has resulted in vague and in some cases unrecognizable descriptions. Recent studies of older type series have revealed that often two or more species were present among "cotypes." This paper attempts to resolve a problem of this type.

In 1955 while checking types in the United States National Museum, the author discovered a perplexing nomenclatorial problem involving two nominal species of Girard. The type series concerned are *Moniana deliciosa* Girard, 1856, USNM 119, which contained 11 specimens and USNM 128, *Cyprinella texana* Girard, 1856 of 6 specimens. Girard's original material included additional specimens now housed at the Museum of Comparative Zoology and the Academy of Natural Sciences of Philadelphia which are listed below. Each of the type series was a composite of two species. Clark Hubbs (1954: 72-3) designated a lectotype for each nominal species. A re-examination reveals that both lectotypes represent the same species. This leaves a well known form without a name.

Identification of the type material and comparisons with fresh specimens are made and nomenclatorial proposals are suggested.

#### ACKNOWLEDGEMENTS

I wish to thank the following: Dr. Clark Hubbs for loan of specimens from the Texas Natural History Collection (TNHC); Dr. Carl L. Hubbs for helpful suggestions during the course of the study; Dr. James E. Böhlke for making materials available at the Academy of Natural Sciences of Philadelphia (ANSP); Dr. Robert H. Gibbs, Jr. for assistance in search of cotypes; Dr. Henry B. Bigelow for making specimens available at the Museum of Comparative Zoology (MCZ); Dr. Reeve M. Bailey for helpful comments; Dr. Ernest A. Lachner for helpful discussions and suggestions, for loan of specimens at the United States National Museum (USNM) and for his generous hospitality extended on my visits to Washington; and Drs. Edward C. Raney and Ernest A. Lachner for reviewing the manuscript.

#### METHODS AND MATERIALS

Counts and measurements were made following the definitions given in Hubbs and Lagler (1947: 8-15). In addition to standard abbreviations for states and compass direc-

tions, the following are used: Co. = County, Par. = Parish, Cr. = Creek, Hwy. = Highway, mi. = mile(s), R. = River, trib. = tributary, and TU = Tulane University.

Type material and specimens originally included in type series.—The number of specimens and the range of standard lengths in millimeters are indicated in parentheses. USNM 119, *Moniana deliciosa*, lectotype (49.6), Rio Leon near San Antonio, Texas, collected by Dr. C. B. Kennerly 1853. USNM 162723, *Moniana deliciosa*, lectoparatype (31.3) (= *Notropis volucellus*); USNM 162724, *Notropis volucellus*, (8, 30-44); USNM 171785, *Notropis texanus*, (50.7); ANSP 4170, *Moniana deliciosa*, cotype, (34.6) (= *Notropis volucellus*) and MCZ 1690, *Moniana deliciosa*, cotype, (2, 30.5 and 38.2) (= *Notropis volucellus*), same locality data and collector as for lectotype of *Moniana deliciosa*. USNM 128, *Cyprinella texana*, lectotype, (46.3), Rio Salado, Texas, collected by John H. Clark, 1851 (?). USNM 162721, *Cyprinella texana*, lectoparatypes, (3, 43.2-45.7); USNM 162722, *Notropis volucellus*, (2, 40.0 and 40.5); ANSP 3010, *Cyprinella texana*, cotype, (37.6) (= *Notropis volucellus*) and MCZ 1693, *Cyprinella texana*, cotype, (35.2) (= *Notropis volucellus*), same locality data and collector as for lectotype of *Cyprinella texana*. ANSP 4131, *Hybognathus stramineus*, lectotype, (51.9) and ANSP 4132-36, *Hybognathus stramineus*, lectoparatypes, (5, 42.6-57.8), Detroit River, Grosse Isle, Michigan. USNM 45555, *Notropis nux*, lectotype (hereby designated), (45.6), Trinity River, Palestine, Texas. USNM 17831, *Luxilus roseus*, lectotype, (53.5), Natalbany River near Tickfaw, Louisiana, collected by J. H. Bean and O. P. Maxson. USNM 67, *Alburnops blennioides*, lectotype (hereby designated), (55.9), Arkansas River near Ft. Smith, Arkansas, collected by Dr. Shumard.

Other material studied—Anal fin-ray counts were made on all the following material. The number of specimens and the range of standard length in mm., and for some the number of specimens involved in pharyngeal tooth counts are indicated in parentheses.

*Notropis stramineus*: Texas—TU 1486 (4, 41-44), Guadalupe R. at Kerrville, Kerr Co., 6 June 1949, (teeth, 4); TU 10367 (15, 36-50), Devils R., 8 mi. N W Del Rio, Hwy. 90, Val Verde Co., 22 June 1955, (teeth, 15); TU 5949 (78, 29-48), Devils R. near Del Rio, Val Verde Co., 17 July 1941, (teeth, 31).

*Notropis texanus*: Texas—TU 10468 (2, 28-31), Nueces R., 0.8 mi. N Barksdale,

Edwards Co.  
2952 (1, 50),  
toyac Bay,  
59, Nacogdoches  
1); TNHC 21-51, N  
mi. W S  
April 192  
21-51), N  
Lavaca Co.  
1759 (2,  
Simmons,  
(teeth, 2)  
Cr., 150'  
21 Febru  
(1, 50), L  
Bend, Tr  
1248 (14,  
Edna, Ja  
TNHC 2  
ramp, 3 m  
Co., 7 A  
(7, 19-47  
Bastrop  
1894 (7,  
mi. E C  
3 Octobe  
43-50),  
Travis C  
40-54),  
4.2 mi. N  
1952; T  
10.1 mi.  
1951, (te  
Onion C  
Travis C  
*Notro*  
21-67),  
Hwy. 87  
4); TU  
mi. N  
1955, (t  
South I  
Hwy. 37  
21); TU  
North I  
Hwy. 25  
10360 (1  
Del Rio  
1955, (te  
Loco B  
W Nac  
7 April  
49), Bo  
McLenn  
52-75),  
S W G  
6 April  
Marcos

Edwards Co., 6 August 1955, (teeth, 3); TU 2952 (1, 53), Naconicho Bayou, trib. to Attoyac Bayou, 6.3 mi. S W Garrison, Hwy. 59, Nacogdoches Co., 6 April 1952, (teeth, 1); TNHC 1873 (29, 33–50), Sabinal R., 2 mi. W Sabinal, Hwy. 90, Uvalde Co., 14 April 1951, (teeth, 26); TNHC 1250 (10, 21–51), Navidad R., 2 mi. N W Seclusion, Lavaca Co., 5 May 1951, (teeth, 10); TNHC 1759 (2, 39 and 42), Nueces R., 10 mi. W Simmons, McMullen Co., 6 December 1947, (teeth, 2); TNHC 1077 (13, 50–55), Barton Cr., 150' below swimming pool, Travis Co., 21 February 1951, (teeth, 12); TNHC 1356 (1, 50), Lake Travis, sand bar at Singleton's Bend, Travis Co., 23 February 1951; TNHC 1248 (14, 19–53), Lavaca R., 1.5 mi. S W Edna, Jackson Co., 5 May 1951, (teeth, 6); TNHC 2620 (5, 46–51), Taylor Slough boat ramp, 3 mi. above dam, Lake Austin, Travis Co., 7 April 1952, (teeth, 5); TNHC 3986 (7, 19–47), Piney Cr., 1.5 mi. N Bastrop, Bastrop Co., 3 July 1953, (teeth, 2); TNHC 1894 (7, 36–48), Colorado R. at Austin, 1 mi. E Congress Avenue bridge, Travis Co., 3 October 1947, (teeth, 7); TNHC 3272 (6, 43–50), Colorado R., at bridge, E Uteley, Travis Co., 13 March 1953; TU 3034 (10, 40–54), trib. to Sabine R. at Sabine R., 4.2 mi. N W Joaquin, Panola Co., 6 April 1952; TNHC 2011 (18, 42–46), Hondo Cr., 10.1 mi. W Castorville, Medina Co., 13 April 1951, (teeth, 11); TNHC 1095 (15, 42–52), Onion Cr. at Bastrop, 8 mi. S E Austin, Travis Co., 6 March 1951, (teeth, 15).

*Notropis venustus*: Texas—TU 10428 (13, 21–67), Guadalupe R. at Comfort, U. S. Hwy. 87, Kendall Co., 5 August 1955, (teeth, 4); TU 10472 (10, 23–61), Nueces R., 0.8 mi. N Barksdale, Edwards Co., 6 August 1955, (teeth, 10); TU 10539 (139, 15–78), South Llano R., 3.9 mi. S W crossing of Hwy. 377, Kimble Co., 6 August 1955, (teeth, 21); TU 10506 (32, 19067) Bear Cr. trib. to North Llano R., 5.4 mi. N W crossing of Hwy. 290, Kimble Co., 6 August 1955; TU 10360 (186, 29–66), Devils R., 8 mi. N W Del Rio, Hwy. 90, Val Verde Co., 22 June 1955, (teeth, 10); TU 3389 (58, 29–77), Little Loco Bayou, trib. to Angelina R., 4.7 mi. W Nacogdoches, Hwy. 21 Nacogdoches Co., 7 April 1952, (teeth, 5); TU 5164 (13, 24–49), Bosque R., 3.5 mi. S China Springs, McLennan Co., 9 April 1952; TU 3504 (3, 52–75), trib. to Naconicho Bayou, 2.5 mi. S W Garrison, Hwy. 59, Nacogdoches Co., 6 April 1952; TU 5090 (11, 46–90), San Marcos Springs at San Marcos, Hays Co.,

12 April 1952; TU 4955 (20, 29–58), Long King Cr., 1.5 mi. W Livingston, Hwy. 190, Polk Co., 14 April 1952; TU 17766 (18, 65–86), trib. to Neches R., 9.6 mi. W Rusk, Hwy. 84, Cherokee Co., 12 April 1958; TU 3859 (37, 25–69), Attoyac R., 5.6 mi. S W Timpson, Hwy. 59, Rusk and Shelby Co., 6 April 1952; TU 2986 (210, 23–58), Bosque R., at Clifton, Bosque Co., 8 April 1952; TU 17785 (4, 53–62), trib. to Neches R., 2.6 mi. W Maydelle, U. S. Hwy. 84, Cherokee Co., 12 April 1958; TU 3412 (2, 48 and 60), trib. to Bowles Cr., 6.2 mi. W Alto, Cherokee Co., 7 April 1952; TU 3798 (41, 26–75), Masons Cr., trib. to Trinity R., 3.7 mi. W Elkhart, Hwy. 294, Anderson Co., 7 April 1952; TU 3483 (55, 28–88), trib. to Neches R., 4.1 mi. E Slocum, Hwy. 294, Anderson Co., 7 April 1952; TU 2943 (11, 26–50), Naconicho Bayou, trib. to Attoyac Bayou, 6.3 mi. S W Garrison, Nacogdoches Co., 6 April 1952; TU 4947 (35, 27–72), Brazos R., at mouth of trib. about 4 mi. S Whitney dam, Bosque Co., 8 April 1952. Louisiana—TU 3370 (14, 23–64), trib. 2.3 mi. E Leesville, Hwy. 21 Vernon Par., 5 April 1952; TU 784 (18, 22–65), Toro Cr., 4.1 mi. S Florien, Hwy. 171, Sabine Par., 3 August 1951; TU 150 (6, 23–48), Mill Cr., trib. to Toro Bayou, 0.5 mi. from Florien, Sabine Par., 23 March 1951.

*Notropis volucellus*: Texas—TU 3502 (9, 36–43), trib. to Naconicho Bayou, 2.5 mi. SW Garrison, Hwy. 59, Nacogdoches Co., 6 April 1952, (teeth, 9); TU 3444 (21, 29–41), Sabine R., 5.4 mi. W Merryville, La., Newton Co., 15 April 1952; TU 3846 (24, 20–38), Attoyac R., 5.6 mi. SW Timpson, Hwy. 59, Rusk and Shelby Co., 6 April 1952, (teeth, 6); TU 3473 (30, 24–43), trib. to Neches R., 4.1 mi. E Slocum, Hwy. 294, Anderson Co., 7 April 1952; TU 10531 (28, 19–39), South Llano R., 3.9 mi. SW crossing of Hwy. 377, Kimble Co., 6 August 1955, (teeth, 10); TU 5020 (5, 39–44), San Marcos Springs at San Marcos, Hays Co., 12 April 1952, (teeth, 5); TU 2949 (23, 25–44), Naconicho Bayou, trib. to Attoyac Bayou, 6.3 mi. SW Garrison, Hwy. 59, Nacogdoches Co., 6 April 1952, (teeth, 10); TU 4533 (83, 21–40), Lampasas R., 3.5 mi. S Belton, Bell Co., 10 April 1952, (teeth, 10). Louisiana—TU 752 (13, 23–45), trib. to Mill Cr., 8.6 mi. S Many, Hwy. 171, Sabine Par., 31 July 1951; TU 5079 (12, 37–44), trib. to Sabine R., 1.6 mi. SE Many, Hwy. 171, Sabine Par., 5 April 1952; TU 3372 (12, 37–45), trib. 2.3 mi. E Leesville, Hwy. 21, Vernon Par., 5 April 1952.



## STATUS OF TYPE SERIES AS OF 1954

Clark Hubbs (1954 (1): 72-73) recognized two species in the type series of *Moniana deliciosa* Girard, 1856. He referred two of eleven specimens to *Notropis deliciosus* (Girard) and designated one as lectotype, which retains the original catalogue number USNM 119; the other specimen was recatalogued as USNM 162723. The remaining nine specimens were determined by Clark Hubbs to be *Notropis volucellus nocomis* and were recatalogued as USNM 162724.

In the same publication Clark Hubbs recognized two species in the type series of *Cyprinella texana* Girard, 1856. Of the six specimens in the series, four were referred to *Notropis venustus* (Girard) and two to *Notropis deliciosus* (Girard). One of the four specimens of *Notropis venustus* was designated a lectotype of *Cyprinella texana* and retains the number USNM 128 and the other three specimens were designated as paratypes of *Cyprinella texana*, USNM 162721. The two designated *Notropis deliciosus* now bear the number USNM 162722.

IDENTIFICATION OF *Moniana deliciosa*  
Girard, 1856

After critical examination and comparison of this type material with fresh specimens the following determinations were made. The lectotype (USNM 119) of *Moniana deliciosa* is not referable to *Notropis deliciosus* (as known by current workers and henceforth referred to in this paper as *Notropis stramineus*) but equals *Notropis texanus* (Girard), 1856; the lectoparatype of *Moniana deliciosa* is equal to *Notropis volucellus nocomis* and of the remaining 9 specimens which were designated as *Notropis volucellus nocomis* eight remain as such and one (USNM 171785) represents *Notropis texanus*, currently known as *Notropis roseus* (Jordan). One specimen of this original type series (including type series at Academy of Natural Sciences of Philadelphia and Museum of Comparative Zoology, which are listed below) lacks the last pharyngeal arch and since it is the only specimen, including cotypes, which does, I assume the set of teeth (4-4) in the osteological collection of the U. S. National Museum marked "type" *Moniana deliciosa*, belongs to this specimen. Thus no specimen of this type series represents *Notropis deliciosus* as known currently.

The lectotype of *Moniana deliciosa* (USNM 119) (Table I) has a pronounced

lateral band which extends anteriorly on the head and includes the upper lip and anterior half of lower lip. This pattern agrees with that of *Notropis texanus* (Fig. 3) and differs from *Notropis stramineus* (Fig. 1). The latter shows little development of a dark lateral band anteriorly; the upper edge of upper lip only is pigmented and the lower part of upper lip and lower lip are usually immaculate. The lectotype has considerable pigment below the row of scales encompassing the lateral line; this is typical of *N. texanus* but is not present in specimens of *N. stramineus* collected from the approximate geographical area in Texas where the "types" were taken. The lectotype has considerable pigment around anus and along the base of the anal fin; *Notropis stramineus* rarely has pigment around the anus and has only a few deep seated melanophores along the anal fin. The lectotype lacks a patch of melanophores at the origin of the dorsal, at posterior base of the dorsal and at the base of anterior upper caudal rays; these patches are typical for *N. stramineus*. The caudal spot of the lectotype is somewhat quadrate in shape rather than the delicate wedge of melanophores found in *N. stramineus* (Figs. 2 and 4). Anal fin-ray and pharyngeal tooth count data are given in Table II and detailed comparisons of measurements are given in Table III. Table IV shows that the lectotype has many characters in common with *N. texanus* and that it differs from *N. stramineus* in those characters. Many additional characters are described for *Notropis texanus* under the name *N. roseus* by Bailey, Winn and Smith (1954) and Suttkus and Raney (1955c).

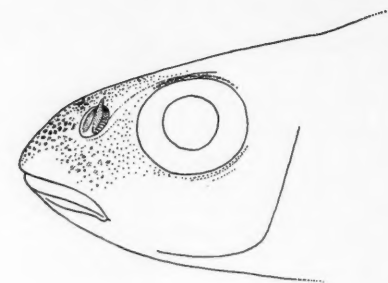
A single cotype of *Moniana deliciosa* (ANSP 4170) exists at the Academy of Natural Sciences of Philadelphia. This specimen apparently was removed from the type series at the U. S. National Museum because a "type" label in the jar bears the number 119 and corresponding locality data. This specimen is a typical example of *Notropis volucellus* (Table I). It has 8 anal rays; 4-4 pharyngeal teeth and elevated lateral-line scales. The dark lateral band extends along lateral-line scale row and its lower margin terminates on the ventral margin of the lateral-line scales. The band extends on to the snout and upper lip. On the caudal peduncle, the lateral band is expanded to form a diffuse oval spot which is constricted posteriorly and is followed by a small wedge-shaped basicaudal spot (Fig. 8). Melano-

TABLE I  
MEASUREMENTS AND COUNTS OF *Notropis* "TYPES"  
Proportions expressed in thousandths of standard length

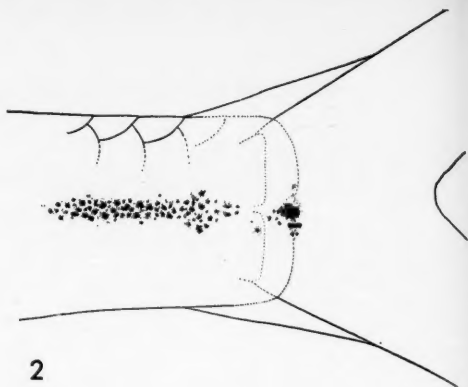


TABLE I  
MEASUREMENTS AND COUNTS OF *Nolopis* "TYPES"  
Proportions expressed in thousandths of standard length

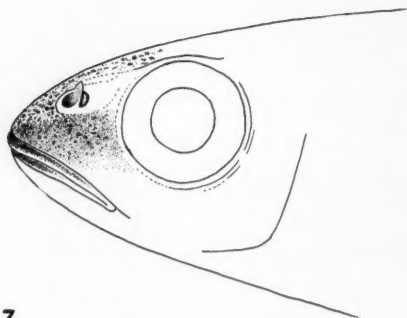
Species	lacunas								volucellus					stramineus		blennius
Museum designation	USNM 119 <i>M. deltoidea</i>	USNM 128 <i>C. texana</i>	USNM 12831 <i>L. roseus</i>	USNM 45555 <i>A. nux</i>	USNM 162721 <i>paratype C. texana</i>	USNM 162721 <i>paratype C. texana</i>	USNM 162721 <i>paratype C. texana</i>	USNM 162723 <i>M. deltoidea</i>	MCZ 1690 <i>C. texana</i>	MCZ 1690 <i>C. texana</i>	ANSP 4170 <i>M. deltoidea</i>	MCZ 1693 <i>C. texana</i>	ANSP 3010 <i>C. texana</i>	ANSP 4131 <i>H. stramineus</i>	USNM 67 <i>A. blennius</i>	
Standard length	49.6	46.3	53.5	45.6	45.7	45.1	43.2	31.3	38.2	30.5	34.6	35.2	37.9	51.9	55.9	
D. origin to snout	500	486	493	500	512	491	494	536	563	524	529	534	556	545	509	
D. origin to C. base	553	542	537	537	527	537	520	491	513	505	491	488	505	520	518	
D. origin to occiput	311	303	295	302	323	305	312	306	337	347	303	338	343	343	308	
P <sub>1</sub> insertion to snout	482	488	478	491	519	475	492	520	536	—	555	511	502	493	501	
A. origin to C. base	319	314	331	329	331	320	309	306	345	321	341	340	362	353	304	
Body, greatest depth	195	230	213	237	220	236	240	194	264	—	217	221	223	214	234	
greatest width	104	—	114	131	—	—	—	115	123	128	118	116	120	144	—	
D. origin to l.1.	131	129	125	140	137	126	113	115	157	118	139	142	144	142	136	
P <sub>1</sub> insertion to l.1.	86	116	88	94	105	113	106	102	112	—	116	111	104	104	91	
Caudal peduncle, length	223	247	250	221	218	221	229	201	251	226	228	244	237	250	227	
least depth	94	97	99	110	102	99	102	99	115	105	101	99	98	85	113	
Head, length	243	247	248	252	240	243	236	271	272	275	277	261	255	264	266	
depth	149	161	159	173	146	148	148	166	183	151	173	162	162	164	168	
width	125	—	125	136	—	—	—	131	144	131	142	133	143	144	144	
Interorbital, least fleshy	64	—	78	79	81	73	69	88	92	88	95	94	80	87	93	
Snout length	70	75	60	59	76	65	78	86	85	85	81	82	79	79	75	
Eye length	78	86	75	77	76	75	78	86	105	95	92	94	96	90	90	
Upper jaw length	72	67	65	66	76	66	69	80	81	75	90	82	90	83	93	
Suborbital, least width	22	—	30	26	31	25	34	36	38	36	38	37	29	38	27	
D., depressed length	229	228	241	248	235	223	219	239	264	262	248	261	—	218	214	
A., depressed length	179	179	180	180	159	159	159	194	204	210	196	—	—	164	161	
P <sub>1</sub> length	195	170	198	197	172	166	196	210	215	190	208	—	—	189	191	
P <sub>2</sub> length	157	150	170	180	155	155	139	166	204	—	185	176	175	156	130	
Counts	165	170	170	180	155	155	139	166	204	—	185	176	175	156	130	
Dorsal fin	8	8	8	8	8	8	8	—	8	8	8	8	8	8	8	
Anal fin	7	6	7	7	7	7	7	8	8	8	8	8	8	7	7	
Pectoral rays	14-14	13-13	15-14	14-14	13-13	14-14	14-14	14-14	14-14	13-13	14-14	14-14	14-14	14-14	14-14	
Pelvic rays	8-8	8-8	9-8	8-8	8-8	8-8	8-8	8-8	8-8	8-8	8-8	8-8	8-8	—	8-8	
Predorsal scale rows	15	—	15	35	15	15	16	—	16	15	14	—	15	17	15	
Lateral line scales	36	—	36	35	35	34	35	—	36	37	36	36	36	38	36	
Body circumference rows	11-2-2-11	11-2-11	11-2-11	11-2-11	13-2-12	13-2-12	11-2-12	—	9-2-9	10-2-2	11-2-2	—	11-2-10	11-2-11	12-2-11	
Caudal peduncle rows	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	—	—	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	
Caudal peduncle rows	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	—	—	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	5-2-5	
Pharyngeal teeth	2,4-4,2	—	—	—	2,4-4,1	2,4-4,1	2,4-4,2	4-8	4-8	4-4	4-8	4-4	4-4	4-4	2,4-4,2	



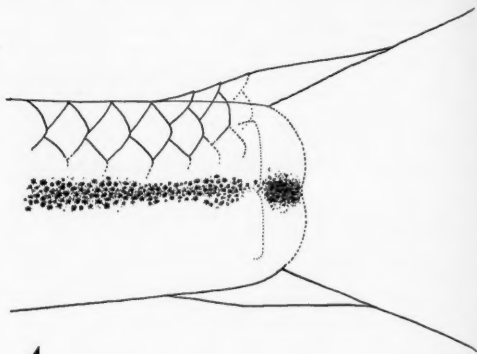
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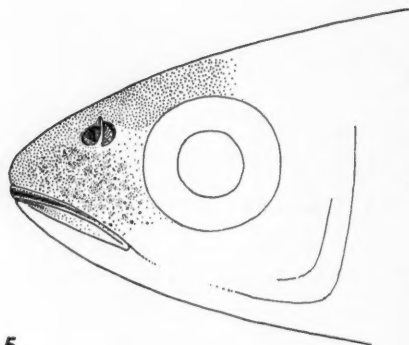
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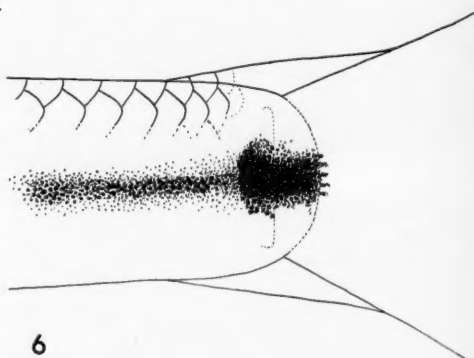
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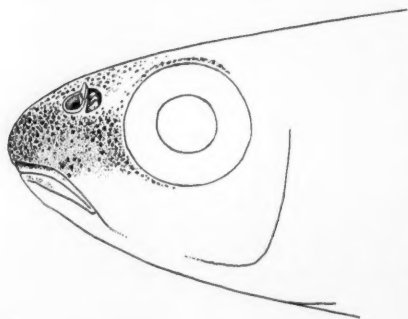
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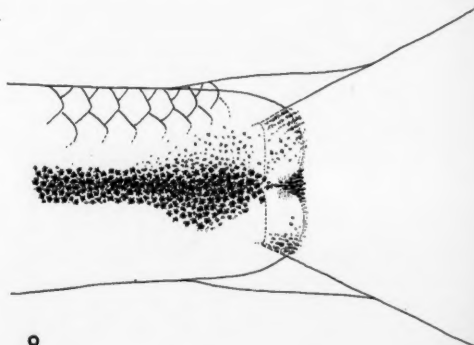
5



6



7



8

Figs. 1-8

phores  
the anal  
ventral,  
the pos  
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phores surround the anus, are found along the anal fin, and form a pronounced median-ventral, post-anal stripe. Melanophores line the posterior margin of the anterior six dorsal fin rays but are lacking along posterior rays of the anal fin. In this cotype the anterior anal rays are broken and the interradial membranes are loose. However, the latter contains melanophores which probably were originally oriented along the posterior margins of the anterior rays. Pelvic fins are clear and the pectoral fins have melanophores along the posterior margin of the anterior two rays. The post-dorsal median stripe is not pronounced. Most of the pigmentation patterns given above are typical of *Notropis volucellus* but atypical for *N. texanus* and *N. stramineus*. Table I includes counts and measurements.

Two cotypes of *Moniana deliciosa* (MCZ 1690) are extant at the Museum of Comparative Zoology. Obviously these were removed from the original "type" series at the U. S. National Museum because one contained label bears the number "119". A note in the bottle by Dr. Carl L. Hubbs reads as follows "Part of types of *Moniana deliciosa* Girard but not true *deliciosa* as restricted by Hubbs and Greene. = *Notropis texanus*; *texanus* x *volucellus*." Carl Hubbs was aware of the composite nature of the type series and he recognized the similarity of the types of *Moniana deliciosa* Girard and *Cyprinella texana* Girard and in addition referred the two specimens (MCZ 1690) to the species *Notropis volucellus*. I concur that the 2 cotypes (MCZ 1690) are *Notropis volucellus*. Both specimens have 8 anal rays. The larger specimen, 38.2 mm. in standard length, has the right pharyngeal arch missing; the left arch has no teeth in minor row and 4 teeth in major row. The smaller specimen, 30.5 mm., has 4–4 teeth. The larger specimen has a developed lateral band which broadens on the caudal peduncle, is followed by an area of few melanophores and ends in a basicaudal spot. Scattered melanophores occur below the lateral line, and extend ventrally to and on to the second row of scales below lateral line row. The dark lateral band is continuous forward on the opercle, the upper part of the iris, and the snout (including the upper lip); a few

melanophores occur on the posterior part of the lower lip. No distinct pre- or post-dorsal median stripe is present. A dense patch of pigment encircles anus and a well developed post-anal median stripe (three or four rows of melanophores in width) is present. Melanophores line the posterior surface of anterior six rays of the anal fin; most are distally located along rays. The anterior six rays of the pectoral fins have scattered melanophores along their posterior margins; the anterior ray is most heavily pigmented. The anterior three rays of the pelvic fins have a few scattered melanophores.

The lateral band of the smaller cotype is essentially the same as that of the larger specimen. The lower parts of the sides are too mutilated to determine the extent of pigmentation. There is a rather distinct median dorsal stripe which is intensified to form a spot at base of the dorsal fin and the upper caudal lobe. Dense pigmentation is found around the anus and along the anal fin; a post-anal median stripe is present; the anal fin is clear; and the pectoral fin pattern is similar to that described for the larger cotype. Measurements and counts of the two cotypes are given in Table I.

The pertinent changes are outlined in the synonymy below to enable easy comprehension of revised nomenclature.

SYNONYMY OF *Notropis stramineus*  
(COPE), 1864

- ? *Minnilus microstomus* Rafinesque, Ichthyologia Ohiensis, 1820, 47.
- ? *Alburnus lineolatus* Agassiz, Bull. Mus. Comp. Zool., I, 1863, 9.
- Hybognathus stramineus* Cope, Proc. Acad. Nat. Sci. Phila., XVI, 1864, 283, Detroit River, Grosse Isle, Mich. (ANSP 4131, lectotype, Fowler, 1918, 24–25).
- Hybopsis missouriensis* Cope, Bull. U. S. Geol. and Geog. Surv. Terr., 1870 (1871), 437, Missouri River at St. Joseph, Missouri.
- Hybopsis scylla* Cope, Bull. U. S. Geol. and Geog. Surv. Terr., 1870 (1871), 438; Red Cloud Creek, tributary to Platte River.
- Cliola chlora* Jordan, Bull. U. S. Geol. and Geog. Surv. Terr., IV, 1878, 791, upper Missouri region.
- Notropis phenacobius* Forbes, Bull. Ill. Lab. Nat. Hist., II, 1885, 2, 137, Peoria, Ill.

Fig. 1. *Notropis stramineus*, TU 10367 (43.9 mm.). Fig. 2. Same as 1. Fig. 3. *Notropis texanus*, TNHC 1873 (41.4 mm.). Fig. 4. Same as 3. Fig. 5. *Notropis venustus*, TU 10472 (45.8 mm.). Fig. 6. Same as 5. Fig. 7. *Notropis volucellus*, TU 5020 (43.0 mm.). Fig. 8. Same as 7. Pattern not intended to be shown on head behind eye nor adjacent to dark lateral band and basicaudal spot on the caudal peduncle and caudal fin. (Drawings by Rudolph J. Miller)

TABLE II  
ANAL FIN-RAY AND PHARYNGEAL TOOTH COUNTS OF FOUR SPECIES OF *Notropis* FROM  
WESTERN TRIBUTARIES OF THE GULF OF MEXICO

Anal rays						
Species	Number of specimens	6	7	8	9	10
<i>stramineus</i>	97	1	96			
<i>texanus</i>	151		146	5		
<i>venustus</i>	1036		6	953	76	1
<i>volucellus</i>	260	1	1	243	15	

Pharyngeal teeth							
Species	Number of specimens	4-4	0,4-4,1	1,4-4,0	1,4-4,1	1,4-4,2	2,4-4,1
<i>stramineus</i>	50	50					
<i>texanus</i>	100					6	
<i>venustus</i>	50		1	3	46		5
<i>volucellus</i>	50	50					89

TABLE III  
MEASUREMENTS OF FOUR SPECIES OF *Notropis*  
Proportions expressed in thousandths of the standard length

Catalog No. and number of specimens	TU 10367 (6) TU 1486 (4)		TNHC 2011 (5) TNHC 1873 (5)		TU 10539 (5) TU 10428 (3) TU 10472 (2)		TU 5020 (5) TU 10531 (5)	
	<i>stramineus</i>		<i>texanus</i>		<i>venustus</i>		<i>volucellus</i>	
	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.
Standard length	39.8-50.0	42.3	38.8-49.8	43.7	34.3-67.1	49.7	34.8-44.3	39.9
D. origin to snout	513-544	523	465-501	488	525-552	537	496-536	519
D. origin to C. base	504-523	513	515-561	541	473-504	494	491-526	505
D. origin to occiput	299-326	309	277-317	298	330-350	338	302-330	317
P <sub>2</sub> insertion to snout	485-515	500	461-502	481	497-525	508	475-502	490
A. origin to C. base	331-350	341	332-359	343	320-366	343	324-354	337
Body, greatest depth	218-258	236	197-246	214	222-282	250	205-235	220
greatest width	132-159	146	119-145	130	122-167	144	123-152	135
Dorsal origin to 1.1.	131-141	137	102-152	129	145-180	161	134-145	137
P <sub>2</sub> insertion to 1.1.	94-123	107	79-122	97	82-117	96	83-103	92
Caudal peduncle, length	224-258	245	234-260	243	202-236	225	212-257	235
least depth	98-108	103	87-95	92	100-118	109	95-105	100
Head, length	252-271	264	240-257	248	244-273	260	246-276	259
depth	159-177	168	142-158	149	155-181	170	151-169	160
width	138-151	147	118-128	122	128-140	136	127-141	134
Interorbital, least fleshy	80-91	85	73-95	82	91-101	95	83-93	89
Snout length	74-82	79	63-83	72	72-95	81	72-85	79
Eye length	79-88	83	74-82	77	62-78	72	81-94	87
Upper jaw length	69-84	78	65-74	70	72-82	76	67-77	72
Suborbital, least width	30-38	33	18-33	27	26-35	32	34-41	37
D., depressed length	214-232	222	211-244	227	202-257	221	211-236	222
A., depressed length	164-182	174	160-194	173	184-224	199	167-195	181
C., base to tip	266-298	276	244-288	269	249-283	267	251-279	271
Pectoral fin length	174-202	192	166-205	184	182-206	195	172-211	188
Pelvic fin length	146-161	154	148-175	163	143-179	162	149-176	159

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*Notropis reticulatus* Eigenmann and Eigenmann, Amer. Nat., 1893, 152, For Qu' Appelle, Assiniboia.

IDENTIFICATION OF *Cyprinella texana*  
GIRARD, 1856

The lectotype (USNM 128) of *Cyprinella texana* is not referable to *Notropis venustus* (Girard), 1856 as identified by Clark Hubbs

*nella texana* are given in Table I. The lectotype lacks pigment on the sides below lateral-line scale row. The dark lateral band is prominent anteriorly and includes the upper lip and the anterior portion of the lower lip. The character of the anterior lateral band is typical of *Notropis texanus*. The lateral band is poorly developed anteriorly on body in *N. venustus*. Figures 3

TABLE IV  
COMPARISON OF THE LECTOTYPE OF *Moniana deliciosa* WITH  
*Notropis texanus* AND *Notropis stramineus*  
Measurements given in thousandths of standard lengths

	<i>M. deliciosa</i>	<i>N. texanus</i>	<i>N. stramineus</i>
Pharyngeal teeth	2, 4—4, 2	typically 2, 4—4, 2	4—4
Position of mouth	terminal	terminal	inferior
Position of dorsal	post dorsal > predorsal distance	post dorsal > predorsal distance	usually post dorsal < predorsal distance
Caudal peduncle, least depth	94	87—95	98—108
Head, depth	149	142—158	159—177
Head, width	125	118—128	138—151
Eye, length	78	74—82	79—88

TABLE V  
COMPARISON OF LECTOTYPE OF *Cyprinella texana* WITH  
*Notropis texanus* AND *Notropis venustus*  
Measurements given in thousandths of standard length

	<i>C. texana</i>	<i>N. texanus</i>	<i>N. venustus</i>
Pharyngeal teeth	2, 4—4, 2	2, 4—4, 2	1, 4—4, 1
Anal fin rays	6	7	8
Position of dorsal	Postdorsal > predorsal distance	Postdorsal > predorsal distance	Postdorsal < predorsal distance
Dorsal origin to occiput	303	277—317	330—350
Dorsal origin to the lateral line	129	102—152	140—180
Caudal peduncle, length	247	234—260	202—236
Caudal peduncle, least depth	97	87—95	100—118

(1954: 72—3) but represents *Notropis texanus* (Girard 1856; the three lectoparatypes (USNM 162721) of *C. texana* designated by Clark Hubbs (1954) are not referable to *Notropis venustus* but also equal *Notropis texanus*. The remaining two specimens of the original type series are not *Notropis deliciosa* as identified by Clark Hubbs (1954) but are *Notropis volucellus*. The latter identification was also made by Hubbs and Ortengruber (1929).

The measurements and counts of the lectotype and the three paratypes of *Cypri-*

and 5 illustrate the typical snout pattern of *N. texanus* and *N. venustus* respectively. The lectotype of *C. texana* does not exhibit on the sides of the body the characteristic diamond-shape pigment pattern which is pronounced in *N. venustus* of Texas, and most of the species of the subgenus *Cyprinella*. The lectotype has a light stripe above the dark lateral band typical of *N. texanus* but absent in *N. venustus*. The pre- and post-dorsal median stripe is narrow and composed of a few rows of melanophores whereas *N. venustus* typically has a

broad, dark stripe. There is no pigment on the dorsal fin membranes such as is typical of adult and juvenile specimens of *N. venustus*. The basicaudal spot of the lectotype is typical of that of *N. texanus* (Fig. 4) in shape and intensity and obviously is not as large as that of *N. venustus* (Fig. 6). In the lectotype the lateral line pores have concentrations of melanophores above and below each pore while *N. venustus* exhibits very little pigmentation around pores. The posterior two rays of the anal fin of the lectotype are margined with pigment which is typical of *N. texanus*; the anal fin of *N. venustus* is usually immaculate.

The lectotype of *Cyprinella texana* lacks pharyngeal teeth *i.e.*, they were formerly removed and not retained in the jar. However, a set of teeth in the osteological collection of the U. S. National Museum is labeled "type" 128 and has the same locality data as the type series. Since the lectotype is the only specimen of the original type series (and cotypes at Museum of Comparative Zoology and Academy of Natural Sciences of Philadelphia) which lacks both pharyngeal arches, I assume that these pharyngeals were removed from the specimen currently labeled "lectotype". The tooth formula 2,4-4,2 is typical of *Notropis texanus*. Two of the lectoparatypes have 2,4-4,1 teeth and the third has 2,4-4,2. A comparison given in Table V shows that the lectotype of *C. texana* agrees with data derived from specimens of *N. texanus* rather than with *N. venustus*. The lectotype has 6 anal rays, an unusual number, and the three lectoparatypes have 7 anal rays whereas the typical count for *venustus* is 8 (Table II). Additional characters are given for *N. venustus* by Gibbs (1957b) and a detailed treatment of its subspecies by Gibbs (1957a).

We thus find that the original series of 6 specimens of *C. texana* now in the U. S. National Museum contains none referable to *Notropis venustus* as indicated by Clark Hubbs (1954).

A single cotype of *Cyprinella texana* Girard in the Academy of Natural Sciences of Philadelphia (ANSP 3010) has been studied by me and is identified as *Notropis volucellus*. This agrees with the conclusions of Hubbs and Ortenburger (1929: 68). It has 8 anal rays, 4-4 pharyngeal teeth and elevated lateral line scales. Its pigmentation is also typical of *Notropis volucellus*. The dark lateral band extends forward on the upper part of the opercle and snout (including

upper lip) but not on the lower lip; posteriorly the lateral band is as described previously for other specimens of *N. volucellus*. There are several melanophores located halfway on each lower jaw; a concentration of melanophores around the anus, along the anal fin, and posterior of the anal fin three rows of melanophores form a median stripe.

One cotype of *Cyprinella texana* Girard exists at the Museum of Comparative Zoology (MCZ 1693). I agree with the identification of this specimen as *Notropis volucellus* by Hubbs and Ortenburger (1929: 68). It has 8 anal rays, 4-4 pharyngeal teeth and markedly elevated lateral line scales. The dark lateral band extends forward on the upper opercle, eye and on snout (including upper lip); posteriorly it is typical of *N. volucellus* as described previously. Heavy pigmentation occurs around anus, along the anal fin and three rows of melanophores compose the median stripe behind the anal fin. The anal fin is damaged and no pigment exists on remaining portion.

Counts and measurements of cotypes ANSP 3010 and MCZ 1693 are given in Table I.

#### SYNONYMY OF *Notropis texanus* (Girard), 1856

- Cyprinella texana* Girard, Proc. Acad. Nat. Sci. Phila., VIII, 1856, 198, Rio Salado and Turkey Creek, Tex. (USNM 128, lectotype, Clark Hubbs, 1954, 72-3).  
*Moniana deliciosa* Girard, Proc. Acad. Nat. Sci. Phila., VIII, 1856, 199, Leon River, a tributary of the San Antonio River, Tex. (USNM 119, lectotype, Clark Hubbs, 1954, 72-3).  
*Luxilus roseus* Jordan, Bull. U. S. Nat. Mus., X, 1877, 61, Natalbany River near Tickfaw, La. (USNM 17831, lectotype, Suttkus and Raney, 1955, 31).  
*Notropis nux* Evermann, Bull. U. S. Fish Comm., XI, 1891 (1892), 77, Neches River, Palestine, Tex. (USNM 45555, lectotype).  
*Hudsonius aletes* Jordan and Evermann, Proc. Calif. Acad. Sci., 4th ser., XVI, 1927, 502, Switz City Swamp, Green County, Ind.

#### DISCUSSION AND SUMMARY

There appears to be no practical way of retaining the specific name *Notropis deliciosa* for the species to which it has been currently applied because there is no

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referable specimen in the extant type material.

There is a choice of which of Girard's names to retain because both lectotypes designated by Clark Hubbs (1954) represent the same species.

Hubbs (1926: 42) and Ortenburger and Hubbs (1926: 126) credit Fowler (1910: 274, 276) as pointing out that Meek erred in his application of the name *Notropis blennius* to *N. deliciosus* but I find no mention of Meek in Fowler's paper. However, because Meek (1894: 76-7) confused the nomenclature by applying the name *blennius* to *deliciosus*, the latter seems to be an undesirable name to retain for Girard's *Moniana deliciosa* and *Cyprinella texana*. Therefore, I choose to retain the name *texana* and place both *Moniana deliciosa* Girard, 1856 and *Luxilus roseus* Jordan, 1877 in the synonymy of *Notropis texanus* (Girard), 1856. This action leaves the species currently known as *Notropis deliciosus* without a name. Apparently the next available name is *stramineus*. ANSP 4131 (51.9 mm. in standard length) was designated by Fowler (1918: 24-5) as the lectotype of *Hybognathus stramineus* Cope, 1864. Measurements and counts of ANSP 4131 are given in Table I. The remaining five specimens in the series (ANSP 4131-6) are likewise *H. stramineus*. These five specimens are 42.6, 55.5, 56.0, 56.2 and 57.8 mm. in standard length.

While this paper was in galley Dr. Carl L. Hubbs kindly informed me he had seen a specimen of *Alburnus lineolatus* Agassiz (in Putnam, 1863: 9) in the British Museum and identified it as a typical specimen of the Ozark race of "*deliciosa*". The specimen (Register No. 1867.4.12.15) is labeled as *Leuciscus lineolatus* and is the specimen described under that name by Günther in the Catalogue of the Fishes in the British Museum, 1868, 7: 259-60. There is some doubt as to whether this specimen is a syntype and so usage of the name *lineolatus* can not be resolved at this time.

The name *xaenocephalus* was misapplied by Hay (1881: 504) and some recent authors to the form herein called *Notropis texanus*. Apparently Bailey, Winn and Smith (1954: 126) were the first authors to show that the name *xaenocephalus* of Jordan, 1876, pertains to a species of the upper Alabama River System.

The nominal form *Moniana deliciosa* Girard (now *N. stramineus*) was treated as

a trinomial (Hubbs and Greene, 1928) and the above procedure now leaves the southern population without a name. This should be treated in a comprehensive study of the subspecies.

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## Results of the Catherwood Foundation Peruvian Amazon Expedition. The Descriptions of Two New Xenurobryconine Characids\*

JAMES E. BÖHLKE

MYERS and Böhlke (1956) brought together three little-known monotypic genera of minute characids and set them apart from all others in a separate tribe, the Xenurobryconini. Onto an essentially generalized characid body plan, these fishes have added a fascinating array of morphological embellishments. While certain of these are shared by all three genera (conical teeth, male caudal scale, the characteristic procurent caudal rays) and make obvious their common descent, there is great morphological diversity between all the xenurobryconine species—so much so as to complicate the generic picture.

We (*ibid.*, 1956) recognized three genera, but our distinctions between *Microcaelurus* A. de Miranda-Ribeiro and *Tytocharax* Fowler were quantitative and not strong. While I have not seen *Microcaelurus*, an examination of the two new species and a re-examination of several of the other described xenurobryconines causes me to doubt the distinctness of these two genera, and they are here united.

The longer mouth, deeper body and larger size of *Microcaelurus odontocheilus* readily distinguish it from *Tytocharax madeirae*, but these are here considered to be characters marking distinct but related species, not distinct genera. If *Microcaelurus* is maintained, then each of the new species herein described should be placed in a separate new genus and all five xenurobryconine

genera be monotypic. The situation is somewhat paradoxical. With discovery of two new forms at one Peruvian location, it is evident that there will be more new xenurobryconines discovered. And since the differences between the known xenurobryconines are of the magnitude of "generic" differences throughout the Characinae (of Myers and Böhlke, 1956), perhaps species yet to be discovered will be found to cluster about the four or five known morphological types and represent as many generic units. At the moment, however, even though each of the described forms represents a rather distinctive morphological type, it would seem ridiculous to interpret the Xenurobryconini as composed entirely of monotypic genera.

*Xenurobrycon* is retained primarily to acknowledge the unique characteristic of the elevated male ventral fins. This is not entirely satisfactory in light of the foregoing discussion (the Peruvian species with the inferior mouth seems just as "different"), but there is the difference here between recognizing an already named genus and erecting new ones. It is not so much that I doubt the validity of *Xenurobrycon* as it is that generic limits are not now apparent in these fishes. While this is not a relict group of fishes, the generic problem is analogous to such a situation; here it is probably the undiscovered forms rather than extinct ones that would clear up the generic problem.

Table 1 lists some of the obvious differences between the xenurobryconine species.

\* This paper is no. 15 in the writer's series "Studies on fishes of the family Characidae."

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7. Lateral

8. Ventr  
9. Maxill  
male

10. Eviden

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aa. Bas  
the  
ma

b. Ad  
c.

cc.

Other characters could doubtless be added if material of Miranda-Ribeiro's species were available.

I wish to thank Dr. Stanley Weitzman of Stanford University for checking several points on the two Stanford paratypes of *Xenurobrycon macropus* SU 40764.

The following is an artificial key to the members of the Xenurobryconini.

- a. Bases of ventral fins of males separated widely and placed rather high on sides; premaxillary teeth of both sexes uniserial (Matto Grosso, Rio Par-

d. Mouth inferior, snout distinctly overhanging; maxillary dentition of males uniserial; ventral rays i,7 (Rio Huallaga, Peru) . . . . . *Tytocharax rhinodus* n. sp.

- dd. Mouth terminal; male maxillary dentition in two or three rows anteriorly, uniserial posteriorly; ventral rays i,6 (Rios Madeira and Amazonas, Brasil) . . . . . *Tytocharax madeirae* Fowler

bb. Adipose dorsal fin absent (Rio Huallaga, Peru) . . . . . *Tytocharax atopodus* n. sp.

TABLE I

A COMPARISON OF CERTAIN CHARACTERS IN THE FIVE SPECIES OF THE TRIBE XENUROBRYCONINI

	<i>macropus</i>	<i>madeirae</i>	<i>odontocheilus</i>	<i>rhinodus</i>	<i>atopodus</i>
1. Bases of ventrals elevated in males? . . . . .	yes	no	no	no	no
2. Adipose fin present? . . . . .	no	yes	yes	yes	no
3. Premaxillary dentition of adult males . . . . .	uniserial.	in broad patches, up to 8 or 9 teeth across at their widest.	"in a thick band."	in about three irregular rows.	in two irregular rows.
4. Mouth . . . . .	terminal.	terminal.	terminal? (not stated).	inferior.	terminal.
5. Maxillary . . . . .	not reaching front margin of eye.	extending just beyond front margin of eye	extending to below middle of eye.	extending just beyond front margin of eye	extending just beyond front margin of eye.
6. Male caudal fin split to its base in the middle? . . . . .	yes	yes	?	no	no
7. Lateral line pores . . . . .	between 2 and 6.	about 6.	"absent"	5 to 7.	3 to 5.
8. Ventral rays . . . . .	i,6	i,6	?	i,7	i,7
9. Maxillary dentition of adult males . . . . .	uniserial.	bi- or triserial anteriorly, the rows widely spaced, uniserial behind.	?	uniserial.	uniserial.
10. Evident maximum size . . . . .	ca. 18 mm.	ca. 18 mm.	30-35 mm.	ca. 32 mm.	ca. 22 mm.

aguay basin). . . . . *Xenurobrycon macropus* Myers and Miranda-Ribeiro

- aa. Bases of male ventral fins placed near the midline, not widely separated; premaxillary dentition in two to nine series.

- b. Adipose dorsal fin present.

c. Maxillary extending posteriorly to below center of eye; greatest depth of body  $2\frac{3}{4}$  times in standard length (near Parintins, Amazonas, Brasil) . . . . . *Tytocharax odontocheilus* Miranda-Ribeiro

- cc. Maxillary extending posteriorly only slightly beyond anterior margin of eye; greatest depth of body 3.2-4.7 times in standard length.

*Xenurobrycon macropus* Myers and P. de Miranda-Ribeiro

*Xenurobrycon macropus* Myers and Miranda-Ribeiro 1945, Bol. Mus. Nac., Rio de Janeiro, zool., n.32: 5, fig. 1 (Type locality: Rio Bodoquena, Matto Grosso, Paraguay basin).

*Tytocharax odontocheilus*  
(A. de Miranda-Ribeiro)

*Microcaelurus odontocheilus* A. de Miranda-Ribeiro 1939, Bol. Biol., São Paulo, n.s., 4 (3): p. 362 (Type locality: not given).  
Remarks.—Paulo de Miranda-Ribeiro

(1955, Arquiv. Mus. Nac., 42 (1): 396), gave "Pará" as the type locality of the species. However, Myers and Böhlke (1956: 7) discussed at some length the origin of the type material, showing that while the immediate source of the specimens was Pará, they apparently originated in the vicinity of Parintins, Rio Amazonas.

*Tyttocharax madeirae* Fowler

*Tyttocharax madeirae* Fowler 1913, Proc. Acad. Nat. Sci. Philadelphia, 65: 564, fig.

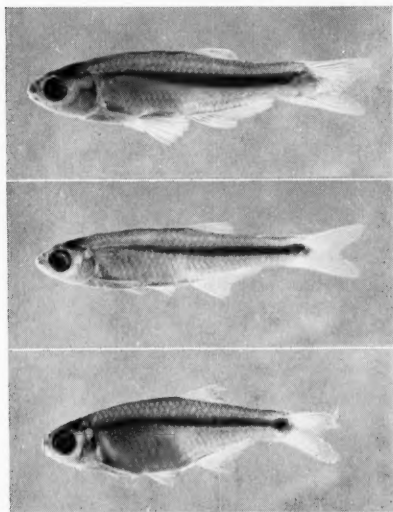


Fig. 1. Top, *Tyttocharax rhinodus*, male holotype, 23.4 mm., ANSP 78707. Middle, *Tyttocharax rhinodus*, female paratype (allotype), 22.7 mm., ANSP 78708. Bottom, *Tyttocharax atopodus*, female holotype, 20.5 mm., ANSP 78714.

20 (Type locality: trib. of Rio Madeira near Porto Velho, Brasil; also several other Madeira localities).

*Microbrycon cochui* Ladiges 1950, Zool. Anz., 145 (11/12): 305, 3 figs. (Type locality: vicinity of Ramon Castillo, near the Brasil-Peru border).

*Tyttocharax rhinodus* sp. nov.

Fig. 1: top and center

**Holotype.**—ANSP 78707, an adult male, 23.4 mm. in standard length, collected by C. C. G. Chaplin and M. H. Hohn on the Catherwood Expedition to Peru, at Sta. 3, Prov. Huanuco: vicinity of Tingo Maria; Cava de Pavos, Quebrada de Puente Perez;

about ¼ mile above Río Huallaga; September 30, 1955; water: clear, with pools and small rapids; time: 10:00 AM–12:30 PM, bottom: rocks and some mud; current: moderate; depth of water: 1–2½ feet; method of capture: rotenone.

**Paratypes.**—ANSP 78708, the figured female, 22.7 mm., with same data as holotype. ANSP 78709, 12, 20.8–32.1 mm., with same data as holotype. ANSP 78710, 12, and 2 in the Natural History Museum of Stanford University, 19.5–24.7 mm., coll. members of the Catherwood Expedition at Sta. 2, vicinity of Tingo Maria; Río Rondos (tributary of Río Monzón), just above new bridge site; September 29, 1955; water: clear and swift; time: 9:30 AM–12:30 PM, bottom: rocks and pebbles, some mud in sheltered spots; distance from shore: edge of river; depth of capture: 1–2 feet; method of capture: rotenone. ANSP 78711, 3 stained and cleared specimens, 20.3–23.0 mm., with same data as the preceding. ANSP 78712, 1, 25.5 mm., coll. C. C. G. Chaplin, M. H. Hohn and Vargas at Sta. 4, vicinity of Tingo Maria; Río Bella (sawmill stream, tributary of Río Monzón) about ½ mile above its entrance into the Monzón, which point is about 6 miles from Puente Prado; October 3, 1955; water: clear; vegetation: heavy, impenetrable growth all along sides of stream; time: 3:00–4:30 PM; bottom: rocks and pebbles; current: swift; depth of water: 1–1½ feet; method of capture: rotenone; water temperature: 25°C. ANSP 78713, 1, 21.6 mm., coll. members of the Catherwood Expedition at an unnumbered station. Peru: Huanuco; vicinity of Tingo Maria; limestone stream (tributary of Río Monzón) near fungus cave, about 2 miles above Río Huallaga. September 28, 1955.

**Diagnosis.**—An elongate, rather large-sized member of the genus, with a long snout, inferior mouth and iii, 13 to iii, 15 anal rays. Greatest depth of body 3.6–4.7 times in standard length. Scales 35 to 37 in a lateral series. Adipose fin present.

**Description.**—Proportions of the holotype and five paratypes are presented in Table 2.

This species has the slenderest body of any known xenobryconine. Body deepest between bases of pectoral and ventral fins. Head proportionately shorter than in the other, deeper-bodied species of *Tyttocharax*, but not nearly so short as that of *Xenobrycon macropus*. Greatest depth of body 3.6–4.7, least depth of caudal peduncle 7.7–

9.0, length.

Diameter 3.0–3.7,

MEASURE

Standard  
Sex  
Greatest  
Snout to  
Snout to  
Snout to  
Snout to  
Depth of  
Length of  
Length of  
Height of  
Height of  
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<sup>1</sup> Holotype

<sup>2</sup> Figure

<sup>3</sup> Appendix

*Tyttocharax*

Standard

Hooks on  
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right...  
Hooks on  
anal...  
Hooks on  
caudal...  
upper...  
lower...

<sup>1</sup> Cou

<sup>2</sup> Thi

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head.  
larger  
orbital  
hanging  
Upper  
hind a  
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9.0, length of head 3.6–3.8, all in standard length.

Diameter of eye 2.7–3.4, length of snout 3.0–3.7, width of bony interorbital 2.9–3.7,

rating posterior one-half or less of the frontals. Parietal fontanel linear, with nearly parallel margins, its width slightly less than that of posterior end of frontal fontanel.

TABLE II

MEASUREMENTS AS THOUSANDTHS OF STANDARD LENGTH OF THE HOLOTYPE AND FIVE PARATYPES OF *Tytocharax rhinodus*, AND OF THE HOLOTYPE AND THREE PARATYPES OF *T. atopodus*

	<i>Tytocharax rhinodus</i>						<i>Tytocharax atopodus</i>			
Standard length (mm.)	22.7 <sup>a</sup>	23.0	23.4 <sup>1</sup>	24.5	29.6	32.1	18.7	19.0	19.0	20.5 <sup>1</sup>
Sex	♀	♂	♂	♂	♀	♀	♀	♀	♀	♀
Greatest depth	220	226	248	245	277	215	273	329	274	302
Snout to dorsal	577	574	577	596	611	592	620	613	592	593
Snout to pectoral	249	259	276	261	247	246	270	287	268	259
Snout to ventral	419	396	393	408	446	435	441	482	442	439
Snout to anal	581	578	581	560	618	600	615	647	616	629
Depth of peduncle	119	117	128	131	125	111	128	126	124	132
Length of pectoral	167	183	182	184	179	164	187 <sup>a</sup>	200	197	205
Length of ventral	126	213	205	214	128	118	144	147	132	139
Height of dorsal	189	—	203	214	186	171	214 <sup>3</sup>	229	211	220 <sup>3</sup>
Height of anal lobe	167	187	184	176	155	—	193	200	192	188
Length of head	264	278	278	278	270	265	283	300	279	273
Diameter of eye	099	091	090	090	079	081	107	105	105	105
Length of snout	088	089	075	082	081	072	080	087	068	071
Bony interorbital	079	096	081	082	081	072	107	095	092	098
Length upper jaw	101	098	094	098	093	086	107	095	105	088

<sup>1</sup> Holotype.

<sup>2</sup> Figured female paratype (allotype).

<sup>3</sup> Approximate; may be too short a measurement, as several of the rays are kinked.

TABLE III

*Tytocharax rhinodus*: MALES—VARIATION IN THE VENTRAL, ANAL AND CAUDAL RAYS WHICH BEAR HOOKS

Standard length ....	21.0	21.6	21.6	21.9	22.5	22.5	22.6	22.8	23.0	23.4	23.4	23.8	24.5	24.7	25.5	28.3
Hooks on branched ventral rays:																
left.....	1	1	1-6	1-7	1-6	1-7	1-7	— <sup>2</sup>	1-7	1-7	1-7	1-7	1-7	1-7	1-6	— <sup>2</sup>
right.....	1	1	1-6	1-7	1-7	1-7	1-7	2-5	1-7	1-7	1-7	1-7	1-7	1-7	1-6	1-7
Hooks on branched anal rays:.....	0	0	2-10	2-12	2-11	2-13	2-13	2-9	2-12	2-12	2-12	1-13	2-12	1-13	1-13	1-13
Hooks on branched caudal rays <sup>1</sup> :																
upper.....		4-7	5-7	3-7	3-7	3-7	3-7	2-7	2-7	3-7	2-7	2-7	1-7	2-7	2-7	2-8
lower.....	0			15-17	16		15-17		16	15, 16	15-17	15-17	15-17	15-17	16, 17	14-17

<sup>1</sup> Counting from top to bottom.

<sup>2</sup> This fin missing.

length of upper jaw 2.6–3.1, all in length of head. Eye equal to, or more often, slightly larger than the snout, snout and bony interorbital about equal. Snout decidedly overhanging lower jaw, so the mouth is inferior. Upper jaw extending backward to just behind anterior margin of eye.

Frontal fontanel a triangular wedge sepa-

Great suborbital completely covering cheek or leaving a narrow free area between its posterior (particularly upper posterior) margin and the preopercle. Postorbitals variously developed, but always leaving naked broad areas behind them. The three stained specimens have three postorbitals on either side, except for one which has only two on the

right side, three on the left. Gill rakers short (the longest perhaps one-third diameter of pupil), slender, 5 or 6 + 10 to 12 on the first gill arch (On the upper limb: with 5 rakers—19 specimens, with 6 rakers—11. On the lower limb: with 10 rakers—14, with 11 rakers—16, with 12 rakers—1.) On several of the specimens, one of the rakers on the lower limb of the first arch is bifurcated.

The three stained specimens have teeth as follows. All teeth strictly conical, with recurved, sharp tips. Premaxillary teeth irregularly in about three rows, the one to three teeth of the outermost series jutting forward. This, coupled with the protruding snout, causes many of the premaxillary teeth to lie completely outside the confines of the mouth. Maxillary nearly completely toothed with a single series of denticles, the foremost decidedly jutting outward. Mandibular teeth uniserial. The tooth counts on the dissected jaw bones from one side of a 23.4 mm. male specimen are as follows: premaxillary with 14 teeth arranged in three irregular rows; maxillary with 23 teeth; mandible with 15 teeth, the fourth, sixth and seventh longest. Dorsal edge of maxillary somewhat broadened proximally.

Tip of snout to origin of dorsal 1.6–1.7, length of dorsal fin 4.7–5.8, length of pectorals 5.4–6.1, tip of snout to upper end of pectoral base 3.6–4.1, length of ventrals 4.7–4.9 (males) and 7.8–8.4 (females), tip of snout to insertion of ventrals 2.2–2.5, tip of snout to origin of anal fin 1.6–1.7, height of anal lobe 5.3–6.4, all in standard length.

Origin of dorsal behind middle of standard length, very little before that of anal. Posterior margin of dorsal rounded. Pectorals overlapping ventrals in males, falling short of ventral bases or just reaching them in females. Ventrals reaching nearly past anal origin in males, falling far short of that point in females. Ventral fins of males greatly enlarged, normally arched when opened outward, but their bases not elevated as are those of *Xenurobrycon macropus*. Posterior anal rays considerably shorter in females than in males. Anal margin concave in females, somewhat sinuous (slightly concave anteriorly and convex posteriorly) in males. In profile, the anal base of the male is decidedly convex, that of the female nearly a straight line. Caudal peduncle of some, particularly the larger, males decurved. Dorsal, pectoral, ventral and anal fins of males all longer than those of females. Small sharp hooks are present along certain of the

rays in the ventral, anal and caudal fins of males. Variation in the rays which bear hooks is summarized in Table 3. The hooks on the ventral and anal fins are recurved, their points directed toward the bases of the rays. Those on the caudal are directed somewhat backward, toward the tips of the rays.

There is great sexual dimorphism in the structure of the caudal fin. In females, the caudal is normal; that is, moderately forked, the lobes roughly equal and with rounded tips, and there are no large modified scales over its basal portion. In males, on the other hand, the upper caudal lobe is much the larger and overlaps the lower, the lower rays of the upper lobe are decurved and unequally spaced and those most ventral shortened, and the basal portion of the fin is covered by glandular tissue and a greatly enlarged covering scale. This large scale is ornamented with circuli much as described by Myers (in Myers and P. Miranda Ribeiro 1945: 4) for *Xenurobrycon macropus*. There are several smaller, but enlarged, scales along the base of the huge supraglandular scale. Procurrent caudal rays strongly developed (again, as in *Xenurobrycon*), the tips—particularly of the dorsal ones—protruding and free. The three stained specimens each have five procurrent rays above and below—anterior to the outermost principal caudal rays. Caudal fin not split to its base in the middle in either sex.

Adipose dorsal fin present, rather small, placed well behind the tip of the depressed dorsal fin and behind a vertical through base of last anal ray. All the types possess an adipose.

Scales cycloid, deciduous, with few concentric ridges and few (typically two, on a small sample from below the dorsal fin at mid-body) radii on their exposed portions. Thirty-five to thirty-seven scales in the lateral series beginning with those perforated, of which five to seven bear pores. Lateral scale counts of 17 specimens, many questionable because of missing scales, were 35 (7 specimens), 36 (7), and 37 (3). Pored scales counted on one side only of 14 specimens were 5 (2 specimens), 6 (9) and 7 (3) scales. Eight or nine longitudinal rows of scales between dorsal and anal fins, fifteen or sixteen predorsal scales and fourteen rows around caudal peduncle.

Dorsal rays ii, 7 (32 specimens); ii, 8 (1). Anal rays iii, 13 (14); iii, 14 (18); iii, 15 (1). Pectoral rays i, 8 (20); i, 9 (36); i, 10 (9). Ventral rays i, 7 (64).

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The sex ratio of the type series is 16 females, 16 males and one uncertain young male (?).

**Coloration in alcohol.**—See Figure 1. The primary feature of pigmentation is the black lateral band, which is narrower and more diffuse over the gut region, broadest above the anal fin. At its widest point, this band is much narrower than the eye. This is the usual state; an occasional individual will have the band broadest over the gut region, but if so the band at that point is very diffuse. A very fine darker line of intermuscular pigment down the center of the band. Scales above lateral band outlined by single rows of melanophores. A sprinkling of melanophores on all fins, males with more pigment than females. A narrow line of melanophores along base of anal fin. Three uniserial parallel lines of pigment cells mid-dorsally between head and dorsal fin; occasionally the predorsal pigment may appear as a nearly solid band, but even here the original three lines of pigment can be detected. Top of head rather heavily, though not uniformly, pigmented; there are three centers of pigmentation in the parietal region (the outer ones extending downward and partly visible in lateral aspect), two in the frontal region and two in the nasal region. The last-mentioned are connected via pigment at the snout tip to a group of melanophores below the nostrils, the subnostril pigmentation appears in lateral aspect as a preorbital stripe. Inside of gill chamber, exclusive of gill arches, heavily pigmented, and much of this visible from the outside through the transparent opercle—particularly a narrow curved band along the rear inside margin of the gill chamber, the portion bounded by the pectoral arch.

**Relationships.**—Apparently no closer to any one of the described xenurobryconines than to others. This species is distinguished from all others by its longer snout and inferior mouth. The state of the mouth, whether terminal or not, is not mentioned in A. Miranda-Ribeiro's original description of *Tytocharax odontochilus*; if not terminal as assumed, *T. odontochilus* would still differ greatly from this new species in its shorter snout, deeper body, and more numerous anal fin rays.

*Tytocharax atopodus* sp. nov.

Fig. 1: bottom

**Holotype.**—ANSP 78714, an adult female, 20.5 mm. in standard length, collected by

the members of the Catherwood Expedition to Peru at Sta. 2., near Tingo Maria, see description under Paratypes of *T. rhinodus*, ANSP 78710, above.

**Paratypes.**—ANSP 78715, 2, 18.7–19.0 mm., taken with the holotype. ANSP 78717, 2 stained specimens, 20.0–21.3 mm., taken with the holotype. ANSP 78716, 1, 19.0 mm., coll. members of the expedition at Sta. 1, Huanuco; vicinity of Tingo Maria, main stream of Río Tullamayo near Puerto Nuevo; September 28, 1955; water: clear and cool; time: 10:00 AM–1:00 PM; bottom: pebbles; shore: pebbles, sand and mud; current: swift; method of capture; seines and hand nets.

**Diagnosis.**—A short-snouted species of moderate size and depth (greatest depth 3.0–3.7 times in standard length); jaws equal. Anal fin short, of iii, 12 or iii, 13 (usually iii, 12) rays. Scales 32 to 34 in a lateral series. No adipose fin.

**Description.**—Proportions of the holotype and three paratypes are presented in Table 2. It is unfortunate that the only male specimen of this species was cleared and stained before measuring, but the specimens were started through the staining process before the writer examined all the material carefully and realized there were two new xenurobryconines involved rather than a single species. All proportions in the following description are, then, based on four females.

This species is intermediate in depth between the previous one and the deep-bodied *T. odontochilus*. Head similar in relative length to that of *T. madeirae* and *T. odontochilus*, longer than in *T. rhinodus* and *Xenurobrycon macropus*. Greatest depth of body 3.0–3.7, least depth of caudal peduncle 7.6–8.1, length of head, 3.3–3.7, all in standard length.

Diameter of eye 2.6–2.9, length of snout 3.5–4.1, width of bony interorbital 2.7–3.2, length of upper jaw 2.7–3.2, all in length of head. Eye much larger than snout, bony interorbital greater than snout, bony interorbital and upper jaw equal or one or the other very slightly greater. Jaws equal, mouth terminal. Mouth oblique, the upper jaw extending backward to just behind anterior margin of eye.

Frontal fontanel a short triangular wedge separating the posterior ends of the frontals. Parietal fontanel wider than posterior end of frontal fontanel, its lateral margins convex. Great suborbital completely covering

cheek or leaving but a narrow naked space between its upper posterior margin and the preopercle. Head poorly armored postorbitally, much of the area naked; the two stained specimens have  $1/2$  and  $1/0$  postorbitals and they are variously shaped. Gill rakers short (the longest perhaps one-third diameter of pupil), slender,  $5 + 9$  or  $10$  on the first gill arch. (Three of the four specimens counted have  $10$  lower rakers, the one with  $9$  is not a normal looking gill arch and also has many of the rakers forked.)

The two stained specimens have teeth as follows. All teeth strictly conical, with recurved sharp tips. Premaxillary teeth irregularly in two rows. Maxillary completely toothed with a single series of very slender denticles. Mandibular teeth uniserial. The tooth counts on the dissected jaw bones from one side of the  $20.0$  mm. male specimen are as follows: premaxillary with  $7$  teeth in two irregular rows; maxillary with  $23$  teeth; mandible with  $18$  teeth, the second through fifth flaring outward. Dorsal edge of maxillary considerably broadened to a wide flat-topped flange whose free edge is on the inside face of the bone.

Tip of snout to origin of dorsal fin  $1.6$ – $1.7$ , length of dorsal fin  $4.4$ – $4.8$ , length of pectorals  $4.9$ – $5.3$  (females), tip of snout to upper end of pectoral base  $3.5$ – $3.9$ , length of ventrals  $6.8$ – $7.6$  (females), tip of snout to insertion of ventrals  $2.1$ – $2.3$ , tip of snout to origin of anal fin  $1.5$ – $1.6$ , height of anal lobe  $5.0$ – $5.3$  (females), all in standard length. Origin of dorsal fin behind middle of standard length, distinctly in advance of that of anal. Posterior margin of dorsal fin rounded. Pectorals greatly overlapping ventrals in the male, falling short of ventral bases or just reaching them in females. Ventrals extending just to base of first anal ray in the male, falling far short of anal fin in females. Ventrals of males greatly enlarged, arched when opened outward, their bases not elevated. Posterior anal rays considerably shorter in females than in males; the margin of the fin is concave in females, sinuous (slightly concave anteriorly and slightly convex posteriorly) in the male. In profile, the outline of the male anal base is straight, that of the anal base of the female concave. Small sharp hooks are present along certain of the rays in the ventral, anal and caudal fins of the male, as follows: on branched ventral rays  $1$  through  $6$ , on branched anal rays  $2$  through  $10$ , and on branched caudal rays  $3$  through  $7$ ,  $16$  and  $17$ . The hooks

on the ventral and anal fins are recurved, their points directed toward the bases of the rays. Those on the caudal are directed somewhat backward, toward the tips of the rays. The structure of the caudal fin is similar to that of the preceding species. No adipose dorsal fin.

Scales cycloid, not so deciduous as those of the preceding species, with few concentric ridges and few ( $1$  or  $2$  each on a small sample from below the dorsal at midbody) radii on their exposed portions. Thirty-two or thirty-four scales in the lateral series beginning with those perforated, of which three to five bear pores. Eight to ten longitudinal rows of scales between dorsal and anal fins, fourteen or fifteen predorsal scales and fourteen rows around the caudal peduncle.

Dorsal rays  $ii, 7$  ( $6$  specimens). Anal rays  $iii, 12$  ( $5$ );  $iii, 13$  ( $1$ ). Pectoral rays  $i, 7$  ( $2$ );  $i, 8$  ( $8$ );  $i, 9$  ( $2$ ). Ventral rays  $i, 7$  ( $12$ ). Gill rakers  $5 + 9$  or  $10$  (only one fish with a count of  $9$  on the lower limb, and this possibly abnormal; also, with many of the rakers forked).

*Coloration in alcohol* (females).—Refer to Figure 1. Most apparent is the black lateral band, broadest but most diffuse over the gut region, narrower but more intense on the tail, and widened posteriorly into a caudal spot. Down the center of the band for its full length is a very fine darker line of intermuscular pigment. Scales above lateral outlined by melanophores, but these irregularly in bands rather than in single series. A sprinkling of melanophores on all the fins except the ventrals, but these not gathered to form obvious patterns on any of the fins. A narrow line of melanophores along base of anal fin. Predorsal pigmentation essentially in three narrow parallel rows, though this basic pattern is largely filled in and appears as a more or less uniform band over the anterior half of the space. Top of head, tip of snout and tip of lower jaw dark. Opercle transparent; some of the dark pigmentation of the inside of the branchial chamber visible behind the gill filaments, through the opercle.

*Relationships*.—Distinct from all xenobryconines but *Xenobrycon macropus* on account of the absence of an adipose dorsal fin. Otherwise quite distinct from *X. macropus* (premaxillary dentition, position of male ventrals, general conformation). *Tyttocharax atopodus* is rather similar to *Tyttocharax madeirae* in general body form, but with

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MYERS, GEORGE S., AND JAMES BÖHLKE. 1956. The Xenurobryconini, a group of minute

South American characid fishes with teeth outside the mouth. *Stanford Ichthyological Bull.*, 7 (2): 6-12.

ACADEMY OF NATURAL SCIENCES, NINETEENTH AND THE PARKWAY, PHILADELPHIA, PENNSYLVANIA.

## Ichthyological Notes

THE EARLY LIFE HISTORY OF TWO CYPRINIDS, *NOTROPIS RUBELLUS* AND *CAMPOSTOMA ANOMALUM PULLUM*.—The embryonic development of the rosyface shiner, *Notropis rubellus* (Agassiz) and the central stoneroller minnow, *Campostoma anomalum pullum* (Agassiz) is unknown. Pfeiffer (1955) reported of *rubellus* eggs that "all attempts to hatch them under laboratory conditions were without success." Fish (1932) gave a drawing of a 9.75 mm. *pullum* fry with a description of its pigmentation.

The complete embryonic development of *rubellus* was recorded from observations made during the spring of 1954, 1955, and 1956. Similar observations were made with *pullum* during the spring of 1956.

#### MATERIAL AND METHODS

On May 26, 1956 a collection was made from a spawning group of *pullum* in Wolf Creek, a tributary to Slippery Rock Creek, Mercer County, Pennsylvania. Although *rubellus* adults were not spawning they were also included in the collection which was transported to the hatch house at the Pennsylvania Fish Commission's Hatchery at Linesville. The *pullum* adults were in nuptial colors and covered with tubercles as described by Raney (1940). The *rubellus* were colored as described by Pfeiffer (1955).

A small amount of water was placed in finger bowls and several females stripped of their eggs (using only those eggs discharged from a slight pressure of the sides). These eggs were released directly into the bowls. Six batches of eggs were obtained from both species by this method. Milt was then introduced into the bowls with ground up testes. This concentration of milt and eggs was left standing for 15 minutes, then fresh water was introduced. The finger bowls were then placed in an aquarium. At various times a bowl was removed, placed under a dissecting microscope and the developmental stage recorded. The water temperature in the aquarium was held at 70° F. which

corresponded to the water temperature in the streams at spawning time for *rubellus* and *pullum*.

During the winter and spring of 1955 female *rubellus* were collected from one station on Slippery Rock Creek. These specimens were dissected and their maturing eggs measured. From February 19, 1955 to May 26, 1955 the average growth of the egg diameter was plotted against the water temperature in each of the 14 samples (Fig. 1). All diameters were recorded from fresh material after placing the eggs in water. About 100 eggs were measured per sample from several different females. There is apparently some correlation between water temperature and rate of egg growth during this period.

#### THE UNFERTILIZED EGG

The unfertilized egg of *rubellus* and *pullum* are sphere-shaped and dull gray in appearance. The *rubellus* egg at spawning time is 1.2 mm. in diameter before placing it in water, while the *pullum* is 2.0 mm. When the eggs of both species are placed in water, the chorion is released from the yolk and slowly fills with water. In this condition the *rubellus* egg is then 1.5 mm. in diameter and the *pullum* 2.4 mm.

#### FERTILIZATION

Within twenty minutes after mixing the milt and eggs in the finger bowls, fertilized eggs of both species could be readily distinguished from unfertilized eggs by their general appearance. Fertilized eggs turned bright yellow, adhered to the bottom of the finger bowls and formed a fertilization cone; the chorion became water hardened and very difficult to break. Unfertilized eggs remained dull gray in color, swelled up and did not adhere to the bottom of the bowl.

Fresh water was introduced at this time without disturbing the fertilized eggs adhering to the bottom of the bowl. An average of 20% of the eggs in each bowl were unfertilized.

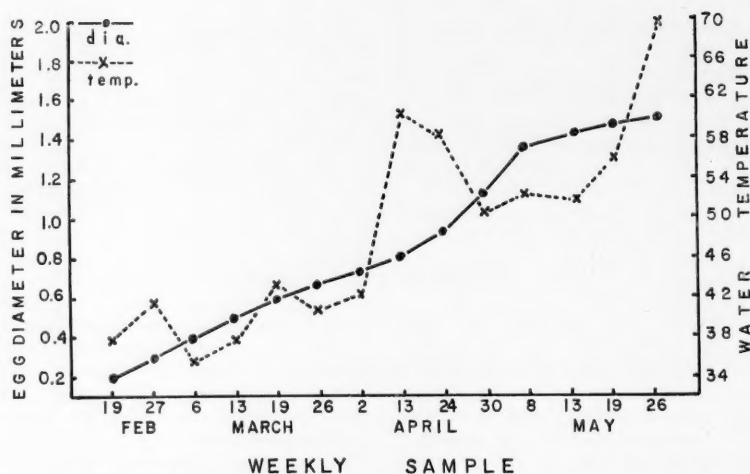


Fig. 1. Average growth rate of maturing *rubellus* eggs sampled from February 19, 1955 to May 26, 1955. The water temperature recorded at each sample indicates some influence with the egg growth.

TABLE I

THE TIME SEQUENCE BETWEEN THE MAJOR DEVELOPMENTAL STAGES IN THE EARLY LIFE HISTORY OF *Notropis rubellus* (AGASSIZ) AND *Camptostoma anomalum pullum* (AGASSIZ). ALL TIMES INDICATED ARE FOLLOWING FERTILIZATION

Stage	Rubellus	Pullum
Two-celled ovum	1 hour	2 hours
Four-celled ovum	80 minutes	2 hours 45 minutes
Eight-celled ovum	100 minutes	3 hours
Sixteen-celled ovum	2 hours	3 hours 40 minutes
Early Blastula	3 hours	5 hours 45 minutes
Late Blastula	4 hours	6 hours
Early Gastrula	6 hours	8 hours
Late Gastrula	9 hours	15 hours
Yolk Plug	10 hours	19 hours
Neurula	12 hours	23 hours
Optic Vesicle	16 hours	27 hours
Pigmentation	23 hours	34 hours
Motility	28 hours	37 hours
Retinal Pigment	33 hours	45 hours
Hatching	57-59 hours	69-70 hours

These were "picked off," leaving approximately 100 fertilized eggs per bowl. During the course of development some eggs were removed and preserved for future study. An average of 10% of the fertilized eggs of both species hatched.

#### DEVELOPMENTAL STAGES

By following the developmental stages of *rubellus* and *pullum* it was apparent that they both exhibited early stages typical of all bony fishes. Segmentation is meroblastic and disk-shaped for both cyprinids.

A record was kept following fertilization of the time sequence at each important stage in the development of *rubellus* and *pullum*. This data has been summarized in Table I for comparison. The *rubellus* larva hatched out between 57 and 59 hours following fertilization while the *pullum* larva completed its development in 69 to 71 hours after fertilization had taken place.

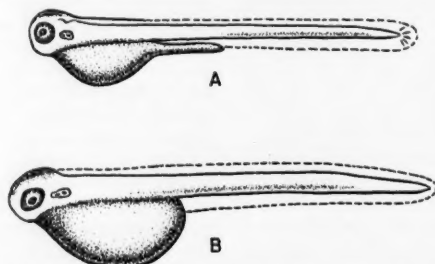


Fig. 2. (A). Line drawing of newly hatched larva of *Notropis rubellus* (Agassiz). (B). Line drawing of newly hatched larva of *Camptostoma anomalum pullum* (Agassiz). Both species drawn from life.

Newly preserved *lus* larva at hatching on measurement. Some of the *rubellus* The *pullum* urements conclusion.

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## LAVRAE

Newly hatched larvae of both species were preserved and measurements taken. The *rubellus* larvae were 5.1 mm. in standard length at hatching time (Fig. 2A). This data is based on measurements recorded from 100 specimens. Some of the specimens used were from successful attempts at studying the early life history of *rubellus* in the spring of 1954 and 1955. The *pullum* larvae were 5.7 mm. based on measurements from 50 specimens obtained at the conclusion of the 1956 study (Fig. 2B).

The larvae of both species were devoid of scales and there was no evidence of an air bladder or lateral line. Pectoral fin buds were present on both cyprinids but were transparent and not easily recognized. Anal and dorsal fins were absent.

Chromatophores were well scattered over the newly hatched *pullum* with a heavy distribution over the yolk sac and spreading to a fine degree over the sides of the larva. Heavy pigmentation occurred in the iris.

All larvae hatched during the 1954, 1955 and 1956 studies died within three days.

The author wishes to thank Doctor C. A. Tryon Jr., Director of the Pymatuning Laboratory of Field Biology, for his guidance and helpful suggestions during the early phases of this study. He also wishes to thank Mr. Gerald Zettle, Superintendent of the Linesville Hatchery for his cooperation during the 1956 study.—ROGER J. REED, 134 Highland Road, Pittsburgh, Pennsylvania.

A NEW SPECIES OF CATFISH, FAMILY LORICARIIDAE, FROM ECUADOR.—A collection of fishes sent to the United States National Museum by Dr. Gustavo Orcés V., Universidad Central Museo de Zoologica, Instituto de Ciencias Naturales, Quito, Ecuador, contained an undescribed catfish of the genus *Panaque* Eigenmann and Eigenmann (1889, Proc. Cal. Acad. Sci., 2nd Ser., II, p. 44), who defined *Panaque* as having interopercular spines and spoon shaped teeth on the jaws.

*Panaque albomaculatus* differs from all the other known members of the genus in having white spots on the body and fins.

*Panaque albomaculatus*, sp. nov.

## Fig. 1

**Holotype.**—USNM 167909, Ecuador, tributary of Rio Suno, upper Napo River, 0°47' south latitude, 77°16' west longitude, Rio Pucuno, November 1950, Jorge Olalla, standard length 90.5 mm.

**Paratypes.**—USNM 167908, Ecuador, Province of Napo-Pastaza, Chichirota Bobonaza Rio, upper Pastaza, 2°22' south latitude, 76°36' west longitude, January 1954, R. Olalla, 4 specimens 48 to 77.5 mm. in standard length. Two specimens, Orcés field Nos. 473 and 478 returned to Gustavo Orcés V., Quito, Ecuador, data same as USNM 167908, 49 and 90 mm. standard length. USNM 167910, Ecuador, Rio Cotapino, tributary of Rio Pucuno, 0°40' to 45' south latitude, 77°17' to 22' west longitude, 58 mm. in standard length.

**Description.**—Dorsal rays I,7 (I,7) [first number, counts for the holotype, numbers in parenthesis for all paratypes]; anal rays I,4 (I,4); pectoral rays I,6 (I,6); ventral rays I,5 (I,5); branched caudal rays 14 (14); lateral scutes 27 (24 to 26); scutes between anal and caudal fins 12 (11 to 12); predorsal scutes 3 (3); abdomen covered completely with platelets but naked in smaller specimens; teeth on each side of upper jaw 4 and 4 (4 to 5 on the left side and 4 to 6 on the right side); of lower jaw 4 and 4 (3 to 4 and 4 to 5); for number of teeth see Table I.

The following measurements are expressed in thousandths of standard length: length of head 376 (347 to 380) [tip of snout to posterior edge of temporal plate]; width of head 339 (288 to 336); interorbital width 144 (129 to 159); length of snout 249 (217 to 242); diameter of eye 61 (55 to 69); tip of snout to origin of dorsal fin 455 (419 to 436); tip of snout to anus 663 (610 to 675).

All of the interopercular spines are tipped with brown and curved outward; the inner spines are longer than those on the outer side. The number of spines are fewer and the lengths of the spines are shorter in smaller specimens. In the holotype (90.5 mm. in standard length), the inner spines measure about three times the diameter of eye, while the outer spines measure about one-sixth the diameter of the eye; 50 or more spines are present. In the smallest paratype (48 mm. in standard length), about 18 spines are present and the inner spines are about as long as the diameter of the eye.

The holotype has spines toward the posterior edge of each body plate; they are more numerous, longer and more curved toward the posterior end of the body. In the paratypes the spines are shorter.

**Color in alcohol.**—Body and fins dusky, sparsely covered with white spots. The spots on the abdomen are larger than on the rest of the body and fins, but are absent in the smaller specimens, which lack abdominal plate-

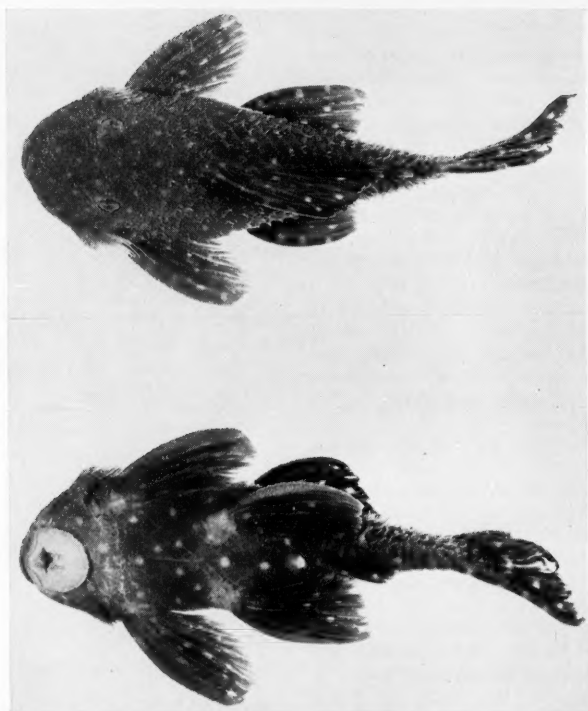


Fig. 1.—Upper, dorsal view of the holotype of *Panache albomaculatus*, USNM 167909. Lower, ventral view of the holotype. Photographed by the Smithsonian Photographic Laboratory.

TABLE I  
NUMBER OF TEETH ON EACH SIDE OF JAWS,  
FOR THE SPECIES *albomaculatus*

upper jaw					lower jaw				
3	4	5	6	7	2	3	4	5	6
—	6	8	1	—	—	1	11	3	—

lets. On the fins they are on both the rays and membranes. Some of those on caudal fin of the holotype run together to form short irregular, vertical bars; the bars are absent in the paratypes.

*Remarks.*—The name *albomaculatus* is given to this species in reference to the white spots on the body and fins, which distinguish it from the other members of the genus.—ROBERT H. KANAZAWA, U. S. National Museum, Washington, D. C.

A TECHNIQUE FOR CONTROLLING THE TIME OF DAILY SPAWNING AND COLLECTING OF EGGS OF THE ZEBRA FISH, *BRACHYDANIO RERIO* (Hamilton-

Buchanan).—Research in and teaching of fish embryology has been emphasized by Creaser (1934, No. 4: 159-62) and more recently by Ingersol and Jones (1949, Proc. Oklahoma Acad. Sci., 30: 260-09) and Orton (1954, Turtox News, 32: 134-8). The zebra fish (*Brachydanio rerio*) is particularly recommended for such purposes because it is inexpensive, hardy and easy to breed. Roosen-Runge (1939, Biol. Bull., 75: 119-33) thoroughly described the early development of this species, and he and W. H. Lewis have prepared a film depicting the development of the egg (The Wistar Institute, Philadelphia). Techniques for obtaining eggs are described in the above papers as well as in hobbyists' handbooks. This note offers a technique for controlling the time of daily spawning and improvements on the standard methods for egg collecting.

A school of 48 to 60 zebra fish in a ratio of two males to one female kept in a 24 in. x 12 in. x 12 in. aquarium, supplies 50 to 100 eggs almost daily throughout the year. For good spawning the fish must be fed four or five times a day on a diet varying from dried

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to live food. Formulas including beef liver are very efficient. An automatic feeder saves much trouble. The optimum temperature is between 75° and 80°F. A combination of day and incandescent light gives very good results although other conditions were not experimented.

Controlling the time of daily spawning is based on the known fact that, other conditions being the same, the zebra fish spawns later in the day in winter than in summer (Roosen-Runge, 1939, *loc. cit.*). Photoperiodicity seems to be the determining factor. Artificial prolongation of the darkness is obtained by permanently covering the back and sides of the aquarium with black cardboard, leaving only the top and front glass to be covered when experimenting on delayed spawning. When completely covered at night, spawning occurred a few minutes after the fishes were exposed to incandescent light the next day. A finely graded period of adaptation was not necessary, for abrupt delays of two hours in morning light exposure were accompanied by a corresponding delay in spawning. By prolonging the dark period by one more hour each day, spawning was delayed until 2:00 PM during months when it should normally take place between 7:00 and 8:00 AM.

Egg collecting is complicated by the cannibalistic habits of the parents. One of the standard methods is to cover the bottom of the aquarium with several layers of multicolor marbles of at least one-half inch in diameter. The eggs lodge between the marbles and are usually removed with a pipette. Most hobbyists put emphasis on a very low level of water in the aquarium. This is to force the spawning to take place at the level of the marbles, thus giving no chance to the parents to eat the eggs. But zebra fish kept in schools never spawn at a distance from the bottom and therefore the 12 in. high aquarium can be filled to capacity.

Egg collecting may be considerably speeded up with the following modifications. To reduce the spawning area (Fig. 1), a glass partition 5 in. in height may be set vertically on the bottom, midway between and parallel to the back and front walls of the aquarium. The back side, filled with white sand to the level of the top of the glass partition, provides ample room for plants. It also serves as a feeding shelf. Spawning will never take place there if white sand is used. The front half of the bottom is covered with marbles. One layer of them seems to be sufficient and makes it easier to get at the eggs with the glass stem of the siphon. Indeed a siphon instead of a

pipette may be used for removing the eggs. The siphon consists of a glass tube of 9 mm. in diameter and longer than the depth of the

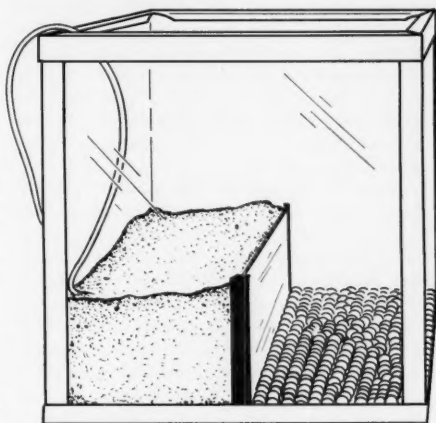


Fig. 1. Side view of a breeding tank showing the sand shelf on the left and the layer of marbles on the right. (Contribution of The School of Natural Resources, University of Michigan.)

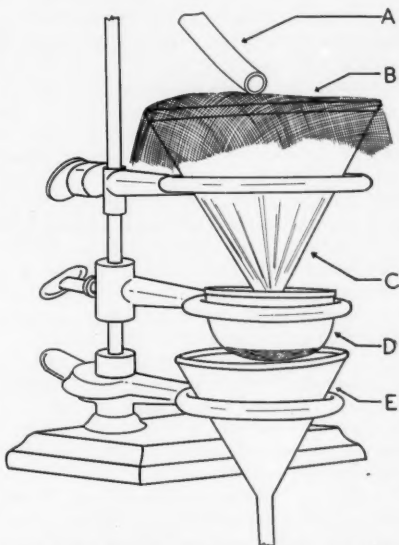


Fig. 2. Egg screening apparatus. A. Lower end of siphon. B. Mosquito screen. C. Funnel. D. Tea strainer. E. Funnel. (Contribution of The School of Natural Resources, University of Michigan.)

water in the aquarium for ease in working between the marbles. This tube is connected to a rubber one provided with a screw clamp to control the outflow. The eggs are siphoned from between the marbles. The water, together

with the eggs and detritus, travels along the glass and rubber tubes, and then falls onto a mosquito screen of larger mesh than the diameter of the eggs (Fig. 2). Here the gross detritus is trapped, and the water and eggs pass through. This fraction is passed into a funnel which directs it over a tea strainer of finer mesh than the diameter of the eggs. The eggs collect on the tea strainer and are carefully washed into finger bowls. Water is then poured into the aquarium to restore the original level.

Even though most of the available space is needed for courtship, the egg laying is confined to a very restricted area, often in the same location each day. Siphoning can therefore be restricted accordingly. In order to reduce the amount of decaying food, solid wastes, etc., collected with the eggs, the entire spawning area may be covered daily after egg collecting. A net made of cheesecloth sewn on a gauge 16 copper wire frame is satisfactory. It may be removed and cleaned at night.—ROMÉO LEGAULT, *Department of Biology, The University of Ottawa, Ottawa, Canada.*

**BEHAVIOR, GROWTH AND MORTALITY IN THE BLUEGILL, *LEPOMIS MACROCHIRUS* RAFINESQUE, FOLLOWING FIN CLIPPING.**—In an attempt to ascertain if fin clipping affects growth in the bluegill, 60 juvenile to adult specimens were seined on May 24, 1954 from San Vicente Reservoir, San Diego County, California, transplanted to an experimental site and divided into four lots. In one lot both pectoral fins were removed using bone forceps; in another the entire caudal fin; in a third, the caudal fin and pectorals; the fourth lot served as a control. Standard length was measured to the nearest mm. using dial calipers. The fish were placed in a concrete reservoir 30 ft. long x 20 ft. wide, with a minimum depth of three feet and a maximum depth of six feet. The reservoir which had not been drained for several years had several inches of silt on the bottom and the sides supported a bountiful growth of filamentous algae.

When first introduced the bluegills in the control group swam toward the bottom as did those with both pectorals clipped. The group with clipped caudal fins sank at first and then wriggled violently; later many of them headed toward the surface. Most of those with both caudal and pectorals removed also sank, seemed to be in a state of shock, and later moved erratically and violently as if to compensate for the loss of fins. A few remained motion-

less at the surface for a short time before the erratic action began.

The experimental fish remained in the reservoir approximately eight weeks at which time an overdose of chlorine killed them. They were all recovered and measured to determine the rate of growth. Because nearly all caudal fins had grown out recognition of a fish to a specific group was very difficult. Regeneration was slower for the pectoral fins. Growth was obviously rapid for all of the fish. The mean length of the entire population at release was 61.9 mm. (Range: 47–90 mm.), and when recovered was 82.2 mm. (Range: 63–110 mm.), an increase of 20.3 mm. in eight weeks. Competition for available food in the reservoir was apparently at a minimum. They were fed only at weekly intervals with sowbugs, angleworms and oatmeal.

The experiment was repeated using two groups and increasing the sample size to obtain more competition. Some 246 bluegills were trucked from the Fish and Game Farm, Valley Center, San Diego County, California, on October 29, 1954. They were measured as before and pectoral fins and the caudal fin were clipped from half of the fish; the others were unclipped as a control. The clipped group ranged from 68 to 102 mm. (Mean: 88.8 mm.), and the unclipped group ranged from 64 to 113 mm. (Mean: 87.2 mm.), at release.

Immediately after liberation the violent wriggling from side to side of the clipped fish was noted as before. Many swam into the sides of the reservoir and were caught and temporarily retained by filamentous algae. Some lay on their sides at the surface for a short time before moving to the bottom. One was observed lying on its side at the bottom five hours after liberation. Most of the fish appeared to have recovered from the initial shock within 10 to 20 minutes after clipping and at this time swam constantly. The day after clipping the two groups had formed separate schools with very little intermingling, apparently due to the reduced mobility of the clipped fish. The clipped specimens stayed in the deepest water. Weekly observations and feeding followed. The same food as before was given. For nearly six months no clipped fish was seen to take any food from on near the surface when in direct competition with an unclipped fish. Vertical movement was much faster in the case of the unclipped specimens. Weekly feeding apparently kept competition at a maximum. Throughout the period of the experiment mortality was high for both groups, presumably because of the lack of sufficient food.

Dead specimens were highly common. After being seined out virtually all of the fish were recovered. Most of the clipped fish were regularly recognized by the groups within a few days. The groups were undernourished. The clipped fish (109 mm.), (Range: 63–110 mm.), in growth. Two groups perimental control 2. due to a among the fin-clipped over 100 three of group 16 and only

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Dead specimens recovered were razor-backed, highly compressed, and in poor condition generally. After one year as many of the fish were seined out as possible and the number included virtually all of the population. A total of 147 were recovered; 87 were unclipped and 60 were clipped. Most of the fins had regenerated irregularly and incompletely which led to easy recognition of the clipped specimens. Both groups were in poor condition and obviously undernourished. The mean standard length of the clipped group was 83.6 mm. (Range: 68–109 mm.), and for the unclipped group 84.4 mm. (Range: 67–112 mm.). A significant difference in growth was not demonstrated between the two groups ( $t$ -test value  $p = 0.6$ ). The experimental group decreased 5.2 mm. and the control 2.8 mm. The smaller average size is due to a differential mortality, it being greater among the largest fish of each group. In the fin-clipped group 23 fish when stocked were over 100 mm. in standard length and only three of these were recovered. Of the unclipped group 16 were over 100 mm. long when stocked and only nine were recovered.

If competition is at a minimum and food is plentiful, growth is rapid despite the clipping. If food is scarce and competition is at a maximum, the growth is either nil or very slow.

I am indebted to the Water Department of the City of San Diego and to the California Department of Fish and Game for aid in obtaining specimens; to Dr. Carl L. Hubbs and Dr. David L. Jameson for suggestions regarding the manuscript, and to John T. Salyer for statistical computations.—RONALD W. CRAWFORD, Department of Zoology, San Diego State College, San Diego, California.

**AN UNUSUALLY COLORED GARFISH, *LEPISOSTEUS PLATYRHINCUS*.**—A garfish collected by Mr. F. G. DuBois on July 6, 1957, near Boynton Beach, Florida, had a bright orange color above shading to orange-yellow on the lower sides and venter. This specimen, 18 inches in standard length, was collected by stunning it with a shot from a .22 caliber rifle. The specimen was received at the Miami Seaquarium and kept on display. In addition to its unusual dorsal and ventral coloration this fish is remarkable in that its eyes are jet black. These contrast with those of the normal spotted garfish which are olivaceous brown.

A similar specimen was speared in a freshwater canal near Miami and was examined by the writer in the summer of 1953.—CRAIG PHILLIPS, Miami Seaquarium, Miami, Fla.

# HISTOZOIC ALGAL GROWTH IN FISH.—

The growth of algae, either as epibionts or symbionts, on or in the tissues of aquatic vertebrates has long been known; the subject was reviewed by Caullery (1952, Sedgwick and Jackson, Ltd.). In spite of the fact that algae have probably been observed growing on the surface of fish, there is very little information in the literature concerning such association.

Recently, Pillay (1953, J. Bombay Nat. Hist. Soc., 51: 378–83) invalidated *Mugil poecilus* Day, 1865, pointing out that this species was the same as *M. troscheli* Bleeker, 1858, since the major distinguishing feature between the two was the presence of "dark spots" on the scales of *M. poecilus*. According to Pillay, specimens of *M. poecilus* in his own collection and those in the collection of the Bombay Natural History Society had the same spots, but irregularly scattered over the body. These were easily removed and, on microscopical examination, were found to be groups of unicellular algae, growing in rather close apposition on the fish scales. Algae were also found on other species of mullets from the same area (Cochin, India).

A kissing gourami (*Helostoma temminckii* C. & V.), from a group that lived for several years in the same brightly illuminated tank in the Aquarium at the Bronx Zoo, was found to have a greenish spot along the right dorso-lateral area, just below the mid-region of the dorsal fin. On closer examination, the spot was found to be below the epidermis and, microscopically, consisted of numerous unicellular algae in various stages of development (Fig. 1). Algal growths were also found within the nasal capsule (Fig. 2) and below the frontal bones, between the eyes. The growth in the nares was composed of both unicellular and filamentous algae (Fig. 3), whereas the algae localized in the intracranial spaces (Fig. 4) were unicellular (Fig. 5). The filamentous form was tentatively identified as a species of *Stigeoclonium* and unicellular forms as members of the Chlorococcales. Although zoospores were present in the cultures, none were seen in the lesions.

The unicellular form isolated from the skin was obtained in bacteria-free culture and passed through six transfers. An inoculum of 0.01 cc. containing approximately 10,000 algal cells was introduced subdermally along the peduncle, anteriorly towards the latero-ventral area of the body of a young gourami, *Trichogaster* sp. The needle was gradually withdrawn, releasing the algal cells in two regions, 2 to 3 cm. apart. A small drop of the culture was accidentally

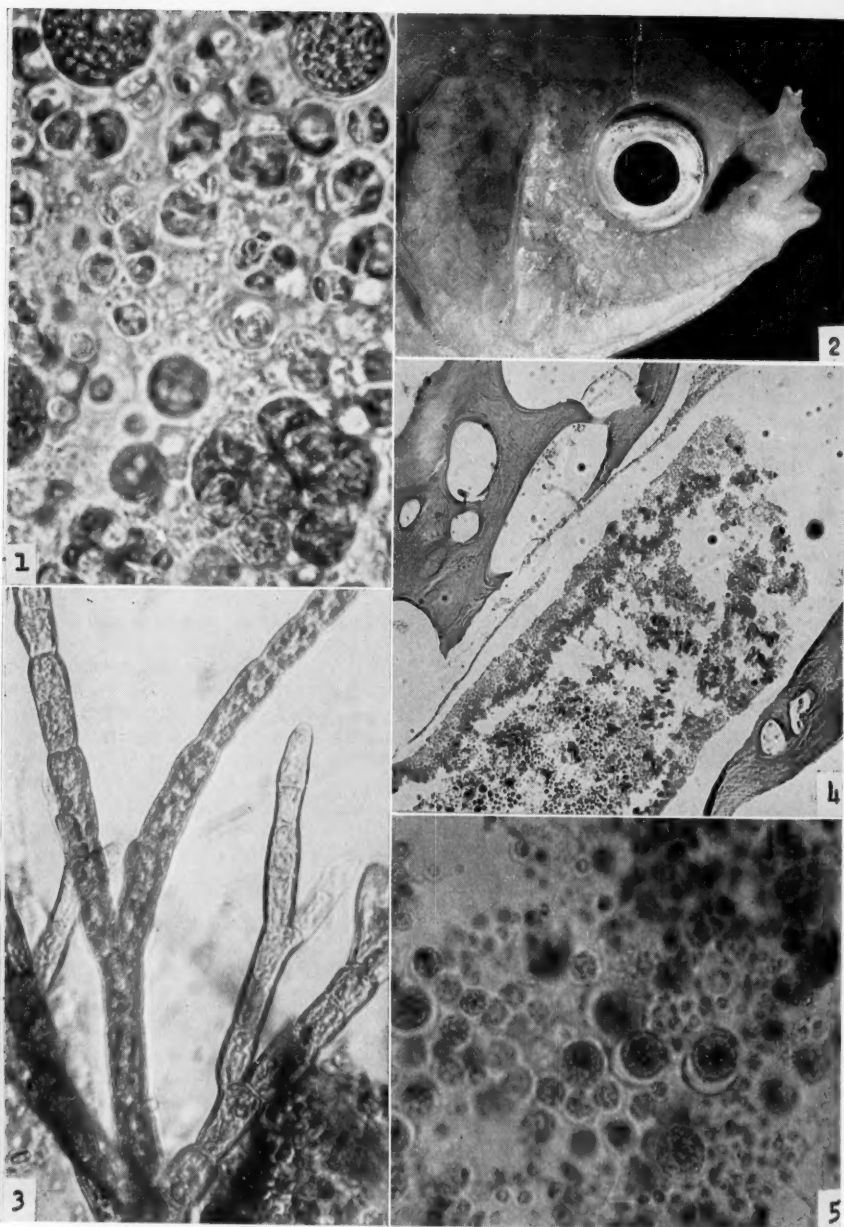


Fig. 1. Wet mount of living unicellular green algae removed from the body of the kissing gourami.  
 Fig. 2. Kissing gourami with the nasal capsule dissected to show the dark area consisting of algal growths.  
 Fig. 3. Wet mount of living filamentous and unicellular green algae from the nares of the kissing gourami.  
 Fig. 4. Section of the skull of the kissing gourami, showing the algae in the intracranial spaces. Hematoxylin-eosin.  
 Fig. 5. Higher magnification of Fig. 4, showing the algae and cellular debris in the intracranial space. Hematoxylin-eosin.

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deposited at the point of inoculation. The fish was kept in a small tank, illuminated with two 10-Watt, cool-white fluorescent tubular lamps. Growth became visible in the three regions of inoculation within 3 months. Within 6 months the size of the growth was doubled, at which time the fish died and was preserved for microscopic examination.

It is to be pointed out that the original observation of algal growth was made on a kissing gourami, which was particularly devoid of pigmentation. The fish lived in a well planted aquarium, with green plants including water sprite, *Sagittaria* and *Vallisneria*. The water, however, was crystal clear at all times and there was no apparent overabundance of green algae. The fish had previously suffered from several attacks of *Lerneid* copepods on various parts of the body, especially near the dorsal head region. These left ulcerated areas, which were probably the points of entry for the zoospores. It is probable that the algae were obtaining some of the elements necessary for photosynthesis and protein synthesis from the body of the fish, especially when located deep in the tissues.

Pillay (1953) reported that the growth on the mullet left prominent depressions varying from minute spots to larger ones of about 3 millimeters. This would indicate that the algae were capable of causing some effect on the host, since it is unlikely that the depressions, presumably erosions, were due to pressure alone.

The kissing gourami exhibiting the algal growth was somewhat emaciated and showed some tissue response, as indicated by the presence of cellular debris and macrophages (Fig. 1). Further, Wright-stained smears of blood from the caudal vessel, heart and gills revealed a definite hypochromic anemia. No eosinophils, neutrophils or basophils were seen in these preparations and only a few small lymphocytes were present. Large mononuclear cells, with primitive characteristics (basophilic cytoplasm and fine basophilic granules) were numerous. Similar cells were present in the spleen and kidney, and the hemopoietic activity in these organs appeared normal. These cells were identified as progranulocytes. The leukopenic effect observed in the kissing gourami, accompanied by a relatively high number of immature elements (progranulocytes) in the peripheral blood, together with a hypochromic anemia, may be related to the presence of toxic substances from the green algae. Aging and possibly nutritional deficiency, however, should not be entirely excluded as the cause of the anemia. Addendum: S. Isokawa, 1956, "An alga growing on the teeth and their surrounding tissues of fish." *Zool. Mag.*, 65 (8): 319-321 (In Japanese with English Summary).—ROSS F. NIGRELLI, *Laboratory of Marine Biochemistry and Ecology, New York Aquarium*, J. J. A. McLAUGHLIN, *Haskins Laboratories, New York City*, and SOPHIE JAKOWSKA, *College of Mount St. Vincent, New York City*.

## Herpetological Notes

RESPONSE OF A GREEN TREEFROG (*HYLA CINEREA*) TO THE CALL OF THE MALE.—The observation noted here is put on record because of the dearth of published observations of the behavior of female anurans in response to the mating call of the males.

On the night of May 28, 1958, A. R. Main and I waded into a large, shallow pool about 25 miles east of Austin, Travis County, Texas. Many green treefrogs (*Hyla cinerea*) were calling on the vegetative mat of this pool in the first breeding peak of the season. Main approached a calling male of this species, which ceased calling as soon as it was touched by his light. Simultaneously, I approached a female of the same species, which was on the vegetative mat about 8 to 10 feet from the male. The female was in an alert attitude,

sitting fairly erect with the right hand grasping the stem of a sedge and facing in the direction of the male. Soon after we turned our lights away from the respective frogs, the male resumed calling. The female immediately dived into the water and swam and hopped rapidly in a direct line to the male, which was facing in the opposite direction to her line of approach. She circled around the male in a clockwise direction and within a few inches of him, but the male did not notice her. She then stopped to his right rear and about 4 to 6 inches away. After a momentary pause she leaped and struck the male on the side. The male turned immediately and clasped her.

There seems no question but that the female responded to the call of the male. It is very doubtful that she had any view of the male,



because of intervening vegetation, when I first saw her, and the fact that she moved to the male immediately after he resumed calling indicates that she was responding to the call. Littlejohn (Copeia, 1958, in press) has reported a gray treefrog (*Hyla versicolor*) responding to the call of the male. Lowe (1954, Tex. Jour. Sci. 9 (3): 265-70) observed females going to the calls of their own kind in a mixed chorus of two species of spadefoots (*Scaphiopus*).—W. FRANK BLAIR, Department of Zoology, The University of Texas, Austin, Texas.

**PARTIAL ALBINISM IN A CHINESE COBRA, *NAJA NAJA* (LINN.).**—Naturally-occurring albinism, although rare, is known among the mammals, birds, reptiles, amphibians, and fishes. The degree to which this lack of normal pigmentation occurs varies greatly, ranging from white-marked or merely abnormally pale specimens to those which are wholly white with pink eyes.

The snake described in this note could be regarded as about 75 per cent albino. It was obtained from a wholesale snake dealer in Hong Kong on May 17, 1958, and was said to have come from Kwangsi Province, South China. The dorsal and lateral scales of this specimen are almost uniformly ivory. The hood, when expanded, is light brown, its marking consisting of a whitish, roughly circular patch with a spot of the same light brown in the center. Posteriorly on the expanded hood there is a broad, transverse, whitish band—all of these dorsal hood markings being due to coloration of the interstitial skin rather than that of the scales (which show much less variation). Ventrally the color is even paler than that of the dorsal aspect, being almost uniform except for the 11th to the 13th and 23rd to 26th ventrals, which are partly brown.

Other data on this specimen are as follows: sex ♀; scales in 21 rows at mid-body; ventrals 172; anal 1; subcaudals 43 (paired); total length 1,110 mm., tail 157 mm.—J. D. ROMER, c/o Urban Council Offices, Hong Kong.

**A POPULATION OF *HAIDEOTRITON* IN FLORIDA.**—Carr (1939, Occ. Pap. Boston Soc. Nat. Hist., 8: 333-6) described a new subterranean salamander, *Haideotriton wallacei*, on the basis of a single specimen, a gravid female, collected from a deep well at Albany, Dougherty County, Georgia. Until recently this was the only specimen known. On December 1, 1957 three blind, white salamanders were collected by Gerard M. Miller and Richard D. Warren in Gerard's Cave (our name) 3.8

miles northwest of Marianna, Jackson County, Florida. This is a distance of 86 airline miles from the only previously recorded locality of *H. wallacei*. Two subsequent trips to the cave that same month resulted in the collection of six more specimens. Numerous other individuals were seen. A comparison of these specimens with Carr's (*op. cit.*) description shows that they are congeneric with *Haideotriton*. At present, we cannot be sure of their specific identity.

The cave is centrally located in the SW quarter of the NE quarter of Sec. 23, T 5N, R11W, as measured on the Cottondale East, Florida, topographic map (USGS). The main part of the cave is a large, long room which runs generally north-south. It is connected to the entrance via a short passageway and a smaller room. No light enters this large chamber. There are three pools in this room from which the salamanders were taken. Two pools are situated in pothole-like depressions in the floor of the room, approximately 140 feet from the cave entrance. They are four feet in diameter and filled with water to a depth of three feet. The third and largest pool is interconnected with the two smaller ones. It extends under the wall of the cave and appears to be rather deep. A small, swiftly flowing stream issues from it and disappears under the opposite wall. The floors of all three pools are covered with a layer of fine silt. The water is clear, with a pH of 6, and a temperature of 67.5°F. Besides *Haideotriton*, the cavernicolous crayfish, *Cambarus cryptodytes*, was taken, and an eel, probably *Anguilla rostrata*, was seen swimming about. *Haideotriton* was observed walking slowly about the bottom or along the lower sides of the pools. One individual was collected near the surface of the water.

Our specimens agree with Carr's in having an extremely long and slender quadrate bone, long gill rami, 11 costal grooves, a moderately compressed tail finned above and below, a strong gular fold extending to the dorsal surface, a spatulate head not suddenly constricted or compressed above or below, vomerine and parasphenoid teeth in continuous series, and the tongue free anteriorly. They differ, however, in certain respects. Each live specimen possesses numerous melanophores distributed over the dorsum and sides. These are absent from the ventral surface and the region of the lateral line organs along the sides. Xanthophores may be distinguished among the melanophores of the dorsum with the aid of a binocular microscope. Specimens in captivity seem to have grown darker in coloration during the month they have been exposed



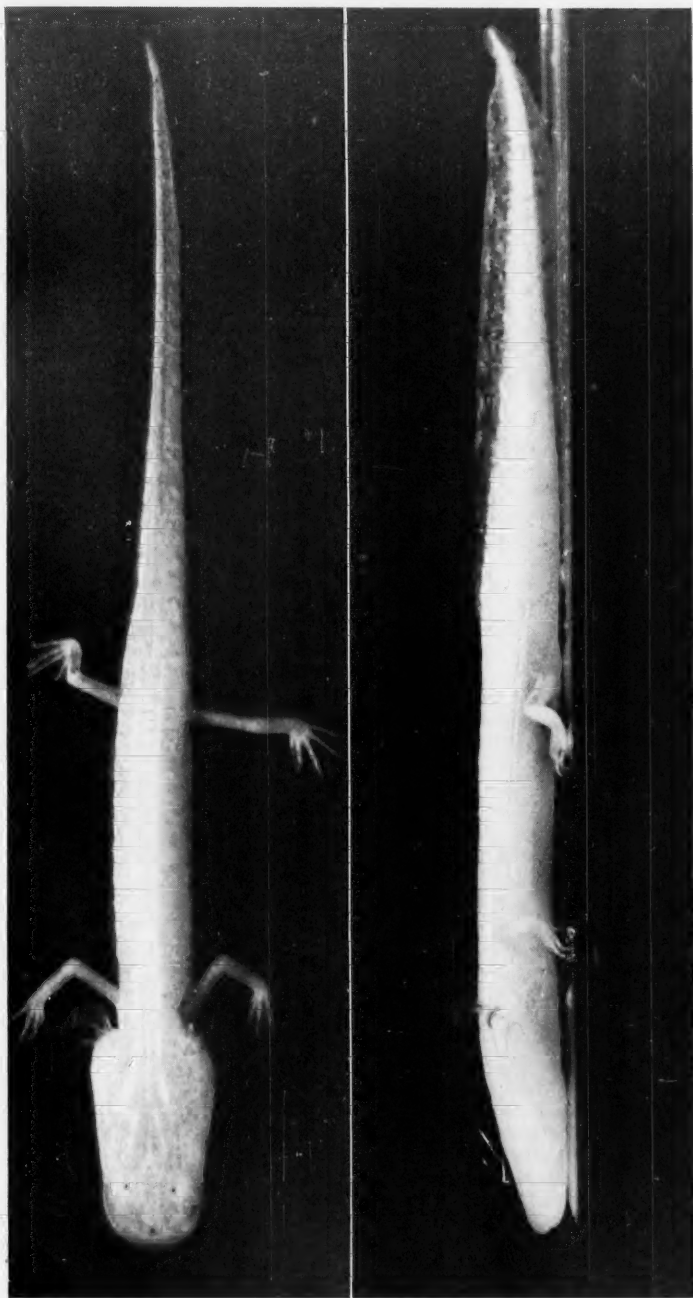


Fig. 1. Dorsal and lateral views of a live specimen of *Haldetrion*, cf. *H. wallacii*, total length 51 mm., collected December 28, 1957, 3.8 miles N.W. of Marianna, Jackson County, Florida. This specimen is now preserved and in the University of Florida Collections (Accession No. 362). Photographs by Gerard M. Miller.

to light. Carr (*op. cit.* p. 335) noted: "In life, body pale, pinkish white, vaguely opalescent; ... tail and fin very faintly, suffused with yellow. ... After preservation, dull white, with widely scattered clusters of dark pigment cells." Our specimens also possess distinct, darkly pigmented eyespots, which were absent from Carr's specimens (see Fig. 1). The tail tip is pointed, rather than round; the quadrate bone is straight, rather than curved. Specimens range in total length from 34 mm. to 51 mm., with a mean of 41.2 mm. These figures are approximate, since the majority of measurements were taken from living specimens. As they desiccate extremely rapidly, individuals could not be removed from the water for accurate measurement. Carr's specimen was 75.5 mm. in total length. In addition to the nine specimens in our possession, numerous other individuals seen did not appear appreciably larger than 50 mm.

The differences noted above may be characteristic of sexually immature *H. wallacei*. The small size and absence of well developed reproductive organs in a 43 mm. specimen dissected December 12, 1957 point to such a conclusion. Since the immature form of *H. wallacei* is unknown, specific identification of our specimens must await the collection of a sexually mature adult.

Of the nine specimens in our possession, three have been preserved in alcohol and one in Bouin's Solution. They have been placed in the University of Florida Collections, Accession No. 362. The remaining five salamanders are being kept alive for laboratory studies in aquaria with water taken from a spring near Gainesville, Florida. They feed readily on enchytreid worms. They do not seem to perceive food until they are in contact with it. At that time, they quickly open their mouths and suck in the food with a snapping motion, then swallow it. They are apparently quite blind, showing no reaction to light. When they were collected, a bright light was played upon them with no reaction elicited. Part of one aquarium containing three individuals is shaded, but they show no preference for remaining in the darkened or lighted areas. Our specimens do not react to sound, as Carr reported, unless the side of the aquarium is tapped sharply. They do react, however, if they are lightly touched or if a water current from a pipette is directed at them. They swim rapidly away just above the substrate holding their legs close to their bodies. Upon striking the side of the aquarium they turn and swim along the side. Occasionally they will swim upward to the surface. After a few seconds they cease swimming and sink gradually to the bottom where they remain quite still.

Many people have aided us greatly in initiating studies. In particular we would like to thank Drs. Walter Auffenberg, Coleman Goin, and William Riemer of the Department of Biology, University of Florida. We would also like to acknowledge the support and interest given us by members of the Florida Speleological Society (a Grotto of the National Speleological Society), especially Gerard Miller, Mrs. Laura Miller, and Peter Drummond.—JOSEPH M. PYLKA and RICHARD D. WARREN, *Department of Biology, University of Florida, Gainesville, Florida.*

**A SARCOPHAGID FLY LARVA PARASITIC IN *ANOLIS CAROLINENSIS*.**—Flies of the family Sarcophagidae have larvae which raise in rotting flesh. A few are found under the skin of turtles and in frog stomachs (Lutz. Field Book of Insects. G. P. Putnam, 192).

An emaciated Carolina anole, 12 cm. in total length, died at the Gulf Coast Research Laboratory. A short while after death of the lizard a large grub, 9 mm. long, crawled out of a hole about halfway down the left side of the lizard just back of the left "elbow." A dark depressed area extended down the lizard's side behind the hole, and apparently the larva had crawled around inside the lizard before emerging. This activity probably caused death of the lizard. The grub was presented alive to Mr. Jesse White, of the Department of Biology, Delta State College, Cleveland, Mississippi, who offered to have it identified.

The larva was returned, unidentified, some six months later, after passing through the hands of entomologists at Mississippi State College, and the Insect Identification and Parasite Introduction Section of the Entomology Research Division, U. S. Department of Agriculture. Mr. C. W. Sabrowsky made the following comment in a letter to Dr. W. W. Neel: "Sarcophagidae—Genus and species?—I returned larva cannot be identified with certainty, but I can call attention to papers by Dodge and by Blake (1955, Proc. Ent. Wash. 57: 183-88). Dodge described a new genus and species of sarcophagid reared from *Anolis carolinensis* from North Carolina. Mrs. Blake, the collector, gave some notes on the rearing." (This species is listed as *Anolisimya blakeae*.)

The lizard and its parasite have been presented to Dr. W. W. Neel, of the Department of Zoology and Entomology of Mississippi State College.—G. GUNTER, *Gulf Coast Research Laboratory, Ocean Springs, Mississippi.*

**OBSERVATIONS ON A CAPTIVE SPECIMEN OF *CLEMMYS INSCULPTA*.**—An adult

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female captured on July 4, 1956 was kept in a small apartment in Boston until September 20, 1956.

She quickly adjusted to the routine of being let out of her glass-fronted cage at 5:30 PM and scraped energetically at the cage door as soon as anyone entered the room at that time. Within one week she learned that her food was always to be found across the room. Without failure, she rushed to the feeding spot as soon as she was released. After eating she walked around the edges of the room for the better part of an hour. She would deviate from her established route if some fairly large object was placed upon the floor where she could see it.

The turtle was placed in a large closet (in which a straw-filled stall had been erected for her) at 10:30 PM each evening during the first week of her captivity. Beginning with the second week, she would enter the closet and go to her stall at approximately the same hour. Deviation in this routine occurred if there was any unusual or altered circumstance by which she was affected (e.g. presence of another person in the room; a large object moved from its customary place). After she had entered the closet, the door was closed until 7:30 AM. When it was opened, the turtle would be waiting just inside the closet, and would walk to her glass-fronted cage and wait to be admitted for the day. (It is interesting to note that two specimens of *T. carolina*, when allowed the same freedom as the *Clemmys insculpta* here described, adopted entirely different patterns of behavior in every instance except that of waiting for the closet door to be opened. Blocking the strip of light which filtered through the cracks of the door-frame made no difference. All three turtles would invariably be waiting when the door was opened at 7:30.)

Whenever any cage building was being carried on in the room during the evening hours (or, for that matter, any project which required work on the floor area of the apartment) the turtle was sure to be found prowling around the work area, not at all alarmed at the confusion, and busily investigating everything, including nails, wood, cartons and even the carpenter.

The turtle deposited an egg on the floor July 14. She had made no previous attempts at nest digging, and merely paused for a moment in her travels, deposited the egg, and continued on her way. When she had circled the room and arrived back at the spot, she stopped, closely investigated the egg and then devoured it.

On July 19 she performed digging motions with her hind feet. A box of sandy dirt was provided; she entered at once. However, she did

not remain in it or try to dig a nest. Instead, she threw dirt onto her shell with her front feet by means of several alternate flips and left the box.

On July 20, after the turtle had been out in the room for about twenty minutes, a partially emerged egg was observed. (The turtle was at the time still walking along the floor.) The reptile was grasped by her carapace and held about three inches over the box of sand until the egg was deposited—a process which took 3 minutes and 21 seconds from the time when the egg (about one-half of which was exposed) was first sighted. After exactly 5 minutes had elapsed, another egg began to appear. Again the process of holding the turtle was begun. This second period of extremely close observation lasted 4 minutes and 15 seconds, during which time the cloaca became widely distended, and a translucent pink in color. The tail was pointed downwards, extending between (but some distance in back of) the two anal laminae. These three points of contact, one of them (the tail) moveable, allowed some regulation of the direction in which the egg was to be released. (This fact was supported when the left anal lamina was lightly rubbed. At once the tail was moved to the left and slightly depressed towards the lamina. This action caused the emerging egg to fall towards the right, away from the area where the rubbing had occurred.) There followed a pause of 15 seconds, after which a third egg appeared. This time, the right anal lamina was rubbed, the tail assumed a position to the right; and the egg was expelled to the left. The laying time was 2 minutes and 26 seconds.

During the laying process, the turtle's hind legs were stretched to their full extent downwards. Slight adjustments were made according to which side the egg was directed in its fall. The eggs were expelled with some force. They emerged in perfect shape, but became slightly flattened on contact with the earth. Therefore they did not roll. There was no cloacal discharge. The turtle's head was frequently drawn into the reptile's shell. Short, gasping hisses occurred periodically. The turtle often opened her mouth wide. The action of retracting her head and neck was performed quickly and in a convulsive manner. When she was placed in the sand (after removal of the eggs) she immediately turned around and investigated the spot behind her.

The following morning, when the closet in which she had spent the night was opened, she was by the door, in the act of eating another egg. When she had finished it, she went to her

cage as usual, and waited until the door was opened and climbed inside.

No further attempts were made at egg laying by the turtle. The eggs were infertile.—HERBERT CLEMENT, 56 Burbank Street, Apartment 17, Boston, Massachusetts.

"THE STATUS OF *TAKYDROMUS KWANGAKUENSIS* DOI."—The name *Takydromus kwangakuensis* was proposed by Doi in 1919, (Chosen Iho, pp. 74-5, fig. 2) from a specimen collected by Hironobu Doi at Kwayakuskan (near Seoul), Keiki Province, Korea, on May 4, 1913. This new species was considered most similar to *Takydromus amurensis* Peters, from which it differed in having four femoral pores on each side; reduced number of enlarged dorsals (seven), and having the three anterior pairs of chin-shields in contact. Doi subsequently, (1929, Korean Biol. Assoc. 9: 2), stated that *T. Kwangakuensis* has only six longitudinal rows of dorsals, as compared with seven in the original description. Doi probably failed to include the reduced median row shown in Figure 2 of his earlier paper describing the form. Shannon (1956, Herpetologica, 12: 40) recognized *T. kwangakuensis* as a valid species, on the basis of "the presence of four femoral pores on each side combined with six rows of enlarged dorsals, and absence of a lateral white line." Dixon (1956, Herpetologica, 12: 53) referred a specimen from P'aur-ri, Korea, having four femoral pores, seven enlarged dorsals, with the median row subequal to the outer rows, to *Takydromus* but did not refer the specimen to either *kwangakuensis* or *amurensis*.

*Takydromus kwangakuensis* has been collected only from the type locality near Seoul, which lies within the extensive range of *T. amurensis*. Only the type specimen, collected in 1913, has been reported. Since considerable collecting in southern Korea during the recent war has failed to produce additional material of *Takydromus kwangakuensis*, I have been led to compare a series of *Takydromus amurensis* with the type description of *kwangakuensis*. Through the kindness of Mr. Alan E. Leviton, Dr. Doris M. Cochran, and Mr. James R. Dixon, I received specimens on loan.

Variation of forty specimens of *amurensis* from Manchuria, Vladivostok, and Korea was studied. Enlarged dorsals numbered seven to eleven, with eight being most common. Seven specimens have eight rows of enlarged dorsals, and no reduced median row; fourteen specimens have six rows of enlarged scales with two median rows of subequal scales (3-2-3 series); three specimens have six rows of enlarged dorsals with a single

median row of subequal scales (3-1-3); two specimens have eight rows of enlarged dorsals with two median rows of subequal scales (4-2-4); one specimen having nine enlarged with a single median subequal row, and one specimen with eleven enlarged dorsal rows. Femoral pores appeared fairly constant, with all but six specimens examined having three pores on either side. Three specimens from Korea have four pores on each side, and three specimens with four pores on the left and three on the right.

Chin-shields appeared fairly constant, with all but two specimens examined having four pairs on either side. One specimen has only three pairs of chin-shields, apparently having the two anterior pairs fused. The two anterior pairs meeting in the middle with occasional specimens having the third pair also in contact.

It is evident that the diagnostic characteristics of *Takydromus kwangakuensis* appear as variants of the sympatric and more widespread *Takydromus amurensis*. *Takydromus kwangakuensis* Doi must be relegated to the synonymy of *Takydromus amurensis* Peters.—HARLAN D. WALLEY, 621 East Center Street, Sandwich, Illinois.

A POSSIBLE INTRODUCTION OF THE SNAKE *TYPHLOPS* IN THE UNITED STATES.—A Blind Snake collected by the late W. F. Shay, "south of Miami, Florida," during the summer of 1930, has been identified by Dr. Neil D. Richmond as *Typhlops lumbricalis*, a species found in the Bahamas, Cuba, and Dominican Republic.

Since it seems possible that *Typhlops* could successfully become introduced in southern Florida, it is hoped that collectors will be alerted for it. The present specimen has been deposited in the University of Florida Collections (UF 8995).—CHARLES W. MYERS, Department of Biology, University of Florida, Gainesville.

ON THE GLIDING OF FLYING LIZARDS, GENUS *DRACO*.—For a good many years I was an interested observer of the flight of various species of *Draco*, from the sun baked atolls and isles of the Sulu Sea on through Mindanao and the Visayas to the plains of central Luzon. No one who ever saw the activities of *Draco* in the field could ever have the slightest doubt about their gliding ability.

In January, 1921 I saw the flight of a *Draco* for the first time. I was staying with a friend in a residence section of the campus of the College of Agriculture, Laguna Province, Luzon. Most of the trees in this area were young, with trunks from 10 to 15 or 18 feet in height.

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I left the house soon after 8 AM and struck across an open grassy area. As I approached a young coco palm a flying lizard took off from it at a height of between 7 and 8 feet. I supposed the lizard was headed for some small trees beside the house, as they were only 25 or 30 feet away. Instead, it headed for a coco palm at the farthest extremity of the open area, passing me at a distance of about five or six feet.

I was familiar with the gliding of flying squirrels in Illinois, and expected to see something similar to their performance. There was a good breeze blowing, just about right for a pleasant cruise in a sailing canoe. Evidently the lizard took full advantage of the air currents, just as good gliders do everywhere, whether turkey buzzards, albatross, human gliders, or *Draco*. When the lizard had gone more than half way toward its objective I expected to see gravity deflect its course perceptibly downward.

To my goggle-eyed amazement just the opposite took place; the path of flight was deflected it is true, but upward instead of downward. As a result of this, plus the terminal upturn that always comes at the end of a flight, the lizard landed at a height somewhat more than 10 feet above the ground. The length of the flight was about 70 feet. I stepped the distance off at the time, as I had no rule or tape measure available.

As Hairston points out in his article in the December COPEIA, the distance covered by most observed flights is conditioned by the distance apart at which coconut palms are planted. I suggest that observers of *Draco* flight have not utilized their opportunities. I know I have not, but then I was supposed to be fishing!

Flying lizards live in other localities than coco palm plantations, and are common on many mountain sides above the coco palm areas, where they live on a variety of broad leaved trees. They are often most plentiful in large old coco palm plantations where the trees are 40 to 50 feet or more in height. To observe them in these upper reaches is difficult but could be done very easily in places where tuba is produced. A *Draco* observer could utilize the facilities provided by the tuba gatherers, who move about freely from tree to tree without descending to the ground.

Hairston states that "flying lizards are normally situated on the vertical trunks of trees." In my experience they are most numerous on tall palm trees in the crown. That is where the flowers and the most insects are located.

That flying lizards do not always go to the nearest tree is readily shown by proper observation in the field.—ALBERT W. HERRE, *Natural History Museum, Stanford University, California*.

**WESTERN RED-BELLIED NEWT IN LAKE COUNTY, CALIFORNIA.**—On April 13, 1958 several dozen were seen and seven specimens of *Taricha rivularis* were collected on Kelsey Creek, south of Kelseyville, California. The location was three and one half miles upstream from the Kelseyville bridge. The site included a small beach opposite a high rocky bluff.

In view of the limited distribution of this species, its discovery in mountains east of the Ukiah Valley is noteworthy. Dr. Victor C. Twitty of Stanford University verified this to be a new location and county record for this species. The specimens have been deposited in the Museum of Vertebrate Zoology, University of California, Berkeley.—JERRY M. PLUTNER, *Department of Fish and Game, Berkeley, California*.

**SNAKES FROM EL SALVADOR.**—During the summer of 1957 two brief visits were made to the Republic of El Salvador. On both occasions opportunity was taken to collect reptiles and amphibians. The snakes thus obtained, though not numerous, are of interest in adding two species to the known fauna of El Salvador, and in adding to the knowledge of variation and distribution of several others. In a collection of 25 individuals, ten species are represented. Some of these were collected at or near the Instituto Tropical de Investigaciones Científicas of the Universidad de El Salvador, about 600 m. above sea level near the city of San Salvador. The environs of the Instituto support a cover of brush, with a considerable amount of cultivated land, not unlike the conditions to be found in suburban areas of any large city. Most of the other specimens were obtained during a two day visit to Hacienda Monte Cristo, about 2200 m. above sea level in the Departamento de Santa Ana. Except where it has been cleared for pasture the vegetation at Monte Cristo is virgin cloud forest, and most of our collecting was done along a road through it. All of the material is now in the collection of the University of Michigan Museum of Zoology.

While in El Salvador, we were guests of the Instituto Tropical de Investigaciones Científicas. To its Director, Dr. Aristides Palacios, we wish to express our thanks for making its facilities available to us and for many other kindnesses during our stay. Many members of the staff of the Instituto gave freely of their time to



assist us, either in the field or at the Instituto. Andrew Starrett aided in collecting the material here reported.

*Bothrops godmani* (Günther).—Two males, UMMZ 117285 and 117286. From Hacienda Monte Cristo. They have 133 and 135 ventrals, 29 subcaudals.

*Drymobius chloroticus* (Cope).—A single male, UMMZ 117284. Obtained at Hacienda Monte Cristo. This is the first record of the species in El Salvador. Scale reduction on the body:

$$21 \frac{4+5(3)}{4+5(3)} 19 \frac{3+4(6)}{3+4(6)} 17 \frac{17}{3+4(97)} 16 \frac{17}{3+4(98)} 15 \frac{3+4(102)}{3+4(99)} 15(170)$$

There are 120 subcaudals.

*Leptodeira annulata rhombifera* Günther.—A single male, UMMZ 117283. Taken at night from low bushes over a stream through pastureland, 13.7 miles north of San Salvador, Departamento de San Salvador.

*Leptodeira septentrionalis polysticta* Günther.—Two specimens. One, UMMZ 117281, from about 1800 m. above sea level on the road between Metapán and Hacienda Monte Cristo; the other, UMMZ 117282, from near Los Chorros, waterfalls formed by a fast-flowing stream, about 1.4 miles east of Colón, Departamento de La Libertad, about 700 m. above sea level.

*Leptophis mexicanus mexicanus* Duméril and Bibron.—A single male, UMMZ 117287. Taken near the Instituto. This species has previously been reported from El Salvador by Brongersma (1954, Koninkl. Nederl. Akad. van Wetenschappen, series C, 2: 159) who had a specimen from the same area as ours. Our specimen lacks keels on the outer three rows of dorsal scales anteriorly and on the outer two rows in front of the vent. Scale reduction formulae for body and tail:

$$21 \frac{5+6(1)}{5+6(2)} 19 \frac{10}{+9(3)} 18 \frac{17}{-3(3)} 17 \frac{3+4(6)}{4+5(4)} 15 \frac{-4(102)}{-4(102)} 13 \frac{5+6(104)}{5+6(103)} 11(163)$$

and

$$9 \frac{3+4(2)}{2+3(2)} 7 \frac{-4(13)}{-2(24)} 6 \frac{2+3(27)}{-2(137)} 4 \frac{-2(133)}{-2(137)} 2(161)$$

*Ninia sebae sebae* (Duméril, Bibron, and Duméril).—Three individuals, UMMZ 117293. From the grounds of the Instituto.

*Rhadinaea godmani* (Günther).—Two males, UMMZ 117290 and 117291. Collected along the road through the cloud forest at Hacienda Monte Cristo. They were found under logs in association with *Rhadinaea montecristi* and *Tropidodipsas fischeri*.

An individual of this species from 1630 m.

above sea level on Volcán de la Lagunita, Departamento de Sonsonate, El Salvador, was described by Mertens (1952, Zool. Anz., 148 (3 & 4): 92) as *Rhadinaea zilchi*. Later, Mertens reduced *R. zilchi* to a race of *R. godmani* (1952, Abh. Senckenb. Naturf. Ges., 487: 70), and recorded it from 1720 m. near Laguna de las Ranas, also in Sonsonate. *R. g. zilchi* was described as differing from *R. g. godmani* in having keels on the dorsal scales above the vent in adult males. Such keels are present on both of the

specimens from Hacienda Monte Cristo. A single topotype of *R. g. godmani*, UMMZ 100516, from Dueñas, Departamento de Sacatepéquez, Guatemala, is an adult male with anal keels. In this specimen, however, they are less strongly developed than in the specimens from Hacienda Monte Cristo. There are slight differences between the topotype of *R. g. godmani* and the Hacienda Monte Cristo specimens in the distinctness of the dark stripes. Both the topotype of *R. g. godmani* and the Hacienda Monte Cristo specimens agree with the holotype of *R. g. zilchi* but not the specimen from Laguna de las Ranas in not having the light eye-mouth line spreading onto the edge of the upper jaw on the sixth supralabial.

Stuart (1951, Contrib. Lab. Vert. Biol. Univ. Mich., 49: 62) has noted variation in head pattern in a population of *R. g. godmani* from southwestern Guatemala. Specimens from near Tejutla lack the dark band which normally separates the light eye-mouth line from the light lip line. The two large males in this series lack anal keels and all of the specimens have narrower dark stripes on the body.

The data presented above indicate that the characters that are supposed to distinguish *R. g. zilchi* are perhaps more variable than has been generally realized. In view of this variation, the differences between the topotype of *R. g. godmani* and the Hacienda Monte Cristo specimens, or between the Hacienda Monte Cristo specimens and the holotype of *R. g. zilchi* seem too slight to be of taxonomic importance. Additional material will be required for a final de-

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termination of the status of Salvadoran *Rhadinaea godmani*.

The two Hacienda Monte Cristo specimens agree in most scale details with both Guatemalan and other Salvadoran material. The ventrals are 170 and 171; the subcaudals, 97 and 91.

*Rhadinaea montecristi* Mertens.—Seven specimens, UMMZ 117292, were collected at the type locality, Hacienda Monte Cristo. These specimens all agree with the holotype in having two postoculars, one plus two temporals, eight supralabials, four and five entering the eye, and 19 dorsal scale rows. Keels are present above the vent in the five adult males. These specimens agree with the single paratype of *R. montecristi* but not with the holotype in having eight instead of nine infralabials. Two of the seven specimens have two preoculars on each side; one has one on one side, two on the other; the others have one on each side. The ventrals in the males range from 158 to 162, with a mean of 160.4; the subcaudals from 79 to 86, mean 83.2. The same counts for the females are 164 and 176, 73 and 78.

Mertens described three forms of *Rhadinaea* from El Salvador, all in the *godmani* group (1952, *op. cit.*; 1952, *Zool. Anz.*, 149 (5 & 6): 136). Two of these, *R. montecristi* with 19 scale rows and *R. pinicola* with 17 scale rows, he considered to be species, related respectively to *R. hemphsteadeae* and *R. lachrymans*, both known to occur in Guatemala. Mertens' idea of the relationship of these forms was apparently based on identity in the number of dorsal scale rows. Another interpretation, involving changes in scale row number by paravertebral loss or addition and fidelity of dark stripes to the scale rows on which they are located, seems at least as plausible to us.

The two Salvadoran species differ from each other strikingly in the arrangement of the dark stripes which form the body pattern. *Rhadinaea montecristi* has, in addition to a narrow vertebral line, a very dark stripe along the outer edge of the ventrals and on the lowermost part of the first dorsal scale row. A second dark lateral stripe occupies the third and adjacent parts of the second and fourth scale rows. *Rhadinaea pinicola* has, in addition to the vertebral line, a dark stripe on the upper half of the first and the lower half of the second scale rows, and a wider line centered on row four, but overlapping onto the adjacent parts of the third and fifth scale rows. A faint line is present on the outer edge of the ventrals.

A comparison of these patterns with those of *R. lachrymans* and *R. hemphsteadeae* reveals a

strong similarity between the pattern of *R. montecristi* and *R. lachrymans*. *Rhadinaea lachrymans* is the only form of the *godmani* group besides *R. montecristi* which has a well defined dark stripe on the outer edge of the ventrals. Further, *R. lachrymans* has a broad dark stripe on the second, third, and fourth scale rows, just as does *R. montecristi*. In pattern, *R. lachrymans* differs from *R. montecristi* in the presence of an additional but weakly defined dark stripe on the common margin of the sixth and seventh scale rows. The pattern of *R. hemphsteadeae* consists of a weak stripe at the outer edge of the ventrals and a wide stripe on the third, fourth, and fifth scale rows, and is, therefore, little like that of *R. montecristi*.

Stuart and Bailey (1941, *Occ. Pap. Mus. Zool. Univ. Mich.*, 442: 7) suggested that dorsal patterns in the *godmani* group of *Rhadinaea* can be interpreted on the basis of loss or addition

TABLE I  
VARIATION IN A SMALL SAMPLE OF *Tropidodipsas fischeri* FROM EL SALVADOR  
CD 7307 has an incomplete tail.

Field Number	Sex	Ventrals	Subcaudals	Supralabials	Infralabials
CD 7305	♂	177	62	6-6	7-7
CD 7306	♂	170	60	5-6	7-7
CD 7309	♂	179	64	6-6	7-7
CD 7307	♀	176	54+	6-6	6-8
CD 7308	♀	184	61	6-6	7-7

of paravertebral scale rows without change in position of the lateral dark stripes. The patterns of *R. lachrymans* and *R. montecristi* are essentially the same; the change between 17 and 19 scale rows may have occurred by paravertebral loss or addition. This interpretation seems simpler than one involving a migration of dark stripes from one to another scale row to account for the differences in pattern between *R. montecristi* and *R. hemphsteadeae*, or between *R. pinicola* and *R. lachrymans*.

The pattern of *R. pinicola* differs basically from that of *R. lachrymans*. It is closer to that of *R. hemphsteadeae*, but differs in having a dark stripe on the common border of the first and second scale rows. Actually, the closest relative of *R. pinicola* may be the generally neglected *R. kinkelini* Boettger (Katalog der Reptilien—Sammlung im Museum der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main. II. Teil (Schlangen). Gebrüder Knauer, Frankfurt a. M. 1898, p. 68), a Nicaraguan species known only from the holotype.

*Tantilla brevicauda* Mertens.—A single juvenile, UMMZ 117289. Taken near the Instituto. It was found under a banana stalk on the ground. It agrees well with the original description. There are 146 ventrals and 25 subcaudals.

*Tropidodipsas fischeri* Boulenger.—Five specimens, UMMZ 117288 (field nos. CD 7305-7309). Taken from under logs along the road through the cloud forest at Hacienda Monte Cristo. These specimens apparently constitute the first record for this species in El Salvador. Variation in the specimens is given in Table I. All possess two postoculars on each side and have supra-

labials three and four entering the eye. In general they agree well with the description given by Boulenger (Catalogue of the Snakes in the British Museum (Natural History), Taylor and Francis, London, 2: 296) except that preoculars are absent in four of the five. The exception, CD 7305, has a large upper and a minute lower preocular on each side. A considerable amount of variation in Guatemalan material of this species has been noted (Stuart, 1951, *op. cit.*).—THOMAS M. UZZELL, JR. and PRISCILLA STARRETT, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

## REVIEWS AND COMMENTS

TRAITE' DE ZOOLOGIE. ANATOMIE, SYSTEMATIQUE, BIOLOGIE. Publie sous la direction de M. Pierre-P-Grassé. Tome XIII Agnathes et Poissons. Anatomie, Ethologie, Systematique. Vol. I (1-924), II (925-1812), III (1813-2758), 6 color plates, 1889 figures. Masson et Cie Editeurs, Paris, 1958: Price of each volume 12,000 francs (bound 13,000).—The publication of more than 2,300 pages of scientific text at the same time is an achievement in itself. The more than sixty chapters are written by 24 authors. Three of them died during the preparation of the work, among them Leon Bertin, and it needs but one glance at the table of contents to realize what his death in 1956 has meant to ichthyology in general and to the editors of this fine work.

The *Traite de Zoologie* is a work for the general zoologist. The main importance of the work, therefore, lies in the nontaxonomic chapters, of which those on gnathostome fishes occupy more than 1,500 pages.

After a short introduction on the classification of vertebrates the Agnatha are dealt with, the Recent with all care down to subspecies, and the fossil ones by the only non-French contributor, E. Stensiö (who distinguishes himself by giving the only phylogenetic tree in the whole work apart from the dendrogram of the relationships of Ceratoids reproduced from Gregory). But with or without graphical expression, here and all through the work the discussions on evolution, phylogeny and classification are well balanced, giving full credit to facts and rival theories.

Well balanced also is the selection of topics

dealt with in the general chapters on gnathostome fishes. Those on the skull aptly illustrate the general approach of the work: selected types are carefully described, the transformations and deviations only mentioned in the systematic part. The chapters on anatomy, physiology and biology are generally of a high standard, many of them (such as those on aquatic and aerial respiration or on the different aspects of reproduction) offering information and vistas not easily found elsewhere in so comprehensive a form. Behavior is not treated separately, but covered to a large extent in the chapters on sense organs and reproduction. Since the chapter on ecology is restricted to a discussion of ecotypes (as in *Le Danois' Vie et Moeurs des Poissons*) such interesting problems as sleeping, schooling and other forms of social behavior remain undiscussed. Similarly, a chapter on food and feeding habits is missing, and the index gives only a reference to the scanty observations on *Latimeria*. That the presentation of special problems is preferred to an overall picture becomes very clear in the chapter on ichthyogeography: after an outline of the problems of distribution in marine fishes (Casier's 1953 essay on the history of distribution of Chondrichthyes not mentioned) the fresh water fishes are discussed generally in one and a half pages, followed by two pages on Africa, and a half page on India and two on Madagascar; the rest of the world is left to Darlington, but his paper of 1948 is neither mentioned nor listed in the bibliography. As a whole, however, the general parts contain a wealth of information,

well digested, and of utterances in general.

The present work is a special one. It is a tempted work, the fish here members, an ichthyology have been bourg some or (In the two she preciated formation to include the Mi (1956) i tionon p and list 2211).

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well digested and presented, and will prove of uttermost importance for further work on general questions in ichthyology.

The parts ichthyologists will look upon with special interest are, of course, the systematic ones. They are impressive—even if one is tempted to give most of the credit for that to the fishes themselves. But in order to be fair here more than elsewhere, it must be remembered that the books do not claim to be an ichthyology, much less a systematic ichthyology (page 2486, third paragraph). It must have been hard enough for Bertin and Arambourg to boil down their material so that some orders occupy just a page or even less. (In the case of Alabiiformes, however, done in two short paragraphs, one would have appreciated at least one reference for further information). But the parts are up to date, even to including, as a suborder of the Clupeiformes, the Miripinnati of Bertelsen and Marshall (1956) in the text and the table of classification on page 1979 (forgotten only in the number and list of suborders of Clupeiformes on page 2211).

The classification adopted regards both Agnatha and Gnathostomata as subphyla (not stated of what phylum but presumably Craniata). The Pisces comprise the four classes Acanthodii, Placodermi, Chondrichthyes, and Osteichthyes, and are treated thus as a superclass. The Osteichthyes contain the subclasses Actinopterygii, Brachiopterygii (for the Polypteriformes), Dipneusti, and Crossopterygii. The Actinopterygii are divided (admittedly more for practical reasons than because of the monophyletic nature of the groups employed) into the superorders Chondrostei (Palaonisci thru Acipenseriformes), Holostei, Halecostomi, and Teleostei. The teleostean orders number 31. In the Clupeiformes are united the Isospondyli, Haplomi, and Iniomi of Regan. On the other hand, the Gasterosteiformes, Aulostomiformes, and Syngnathiformes, and again the Cyprinodontiformes, Amblyopsiformes, and Phallostethiformes, are separated as orders of their own. The whole arrangement is that of a middle course between Romer and Berg. The treatment is broken down to suborders or families, reflecting the interest deserved (and, of course, the information available). The Actinopterygians are followed by short chapters on Dipnoi and fossil Crossopterygii (with very fine details on the estivation of Dipnoi), and a very welcome section on the present knowledge of *Latimeria*.

Of the general features of the work, the figures deserve special mention and praise. The

number of 1889 is that of the captions, the actual number of figures and photographs being much higher. Many of them are original, and generally excellent, done with much care and, whenever it contributes to greater clarity, colored. Judgment on the bibliographies, on the other hand, can not be so laudatory. It would, of course, have been impossible to give anything close to even a condensed bibliography of fishes. Each bibliography attached to the individual chapters is cautiously called bibliographic *sommaire*, but occasionally it is just a bit too summary. Of the four papers specifically referred to for a discussion of characters linking the catfishes directly to chondrosteans and holosteans none could be found in the bibliography of that chapter. They are probably listed in some other chapter, but there is no easy way to tell that. One complete bibliography (complete to the papers cited), would have been a better tool, especially if bound separately together with the index. The index gives references only, no cross-references, and to find any information on topics not in the index (as, for instance, behavior, or food) one has to turn to the table of contents at the end of the third volume. And this is no easy task due to the crowded make-up of its pages.

But the mentioning of such shortcomings of a technical nature should not obscure the fact that it is a fine and tremendous work which has been here presented to the zoological world.—GERD VON WAHLERT, *Museum of Comparative Zoology*.

**LIVING RESOURCES OF THE SEA.** Opportunities for Research and Expansion. By Lionel A. Walford. Ronald Press, New York, 1958: 321 pp., 23 maps, \$6.00 (A Conservation Foundation study, undertaken as a result of a grant from the Rockefeller Foundation).—The author has attempted to bring together and present in non-technical language the many subjects which relate to the use of marine plants and animals. This is an ambitious undertaking, for nothing short of a series of volumes could hope to review the scientific, economic, engineering, and sociological factors pertaining to the subject. But through the careful selection of material from many fields, the author has provided an instructive synoptic picture, one which shows the complexities of the natural system which generates huge amounts of living substance and the complexities inherent in men's attempts to benefit from this production.

From the general premise that scientific research, coupled with increased engineering and educational effort, is requisite to the fuller use

of living marine resources, the author suggests certain fields which are most in need of intensive study and how and where such studies might best be accomplished. The use of generalized outline maps which depict various factors conducive or inimical to basic production in the oceans, the climatic factors influencing the ability of vessels to remain at sea, the areas with immediate need for more protein food, and our relative knowledge of the sea and its organisms contribute to these valuable and effective summaries, summaries of conditions but also summaries of our knowledge and our ignorance.

The author writes as one of a growing group of fishery biologists who believe that the intensive study of the present major species of food fishes, though essential, cannot alone greatly increase the harvest from the sea, but that the entire hydrographic and biological environment must eventually be understood. He does not depreciate the accomplishments of those investigations which have concentrated on the major species, but stresses the urgent need for new information of all kinds, complete studies of environments, animal behavior, zoogeography, physiology, biochemistry, and so on. Readers of *Copeia* will be interested in the author's remarks on systematic biology, for its importance to the future development of the marine fisheries and an understanding of the marine environment is not only the subject of an entire chapter but is apparent throughout the volume. He notes that the first phase of the study of a new area should include a quantitative, systematic study of the fauna and flora of that area.

Part One of "Living Resources of the Sea" is devoted to the general question of how marine resources can be increasingly harvested for the benefit of man. This section includes discussions of conservation, ecology, behavior, systematics, disease, poisons, and fishing tech-

nology, as well as factual discussions of two fields of common current interest: the harvesting of plankton, and the "farming" of certain marine habitats. The second part is a discussion of various groups of organisms, what they now contribute to the total catch of marine life, and what can be expected from them in the future. Dr. Walford's comprehensive study shows him to be an idealist, for his proposals seem hopelessly far-reaching when compared with existing research programs and the financial and technical requirements of a substantially greater effort. On the other hand, his appraisal of research needs is realistic, and it is certainly a welcome change from the unrestrained speculation and unfounded predictions which prevail in the current epidemic of literature and lectures about the sea. The fuller use of the living resources of the sea will require many answers from many fields, answers both costly and vital; "Living Resources of the Sea" presents essential background information for those interested in providing these answers.—GILES W. MEAD, *United States Fish and Wildlife Service, U.S. National Museum, Washington, D.C.*

**REPTILES ROUND THE WORLD.** A simplified natural history of the snakes, lizards, turtles, and crocodilians. By Clifford H. Pope. Illustrated by Helen Damrosch Tee-Van. New York, Alfred A. Knopf, 1957.—This book will be welcomed by all who have children, like the author, but know less about herps than the author does. Mr. Pope has taken great care in providing answers to all questions one is usually asked by children or laymen. Nevertheless he has managed to make it one coherent story, told with an occasionally grim or strained humor, and amply illustrated by the broad pencil of Mrs. Tee-Van.—GERD VON WAHLERT, *Museum of Comparative Zoology.*

## EDITORIAL NOTES AND NEWS

Royal D. Suttkus **D**<sup>R. SUTTKUS</sup> was Acting Editor of *Copeia* during the absence of the Editor-in-Chief.

### Rephibia

**T**he Reptile Club of New York City, on entering its fourth year, began the experimental publication "Rephibia."

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This publication is designed for, as well as written by the amateur... especially youngsters ranging in age from 10 to 17 years old. It has been the trend in recent years, especially about New York City, to give the student more science of his own. We give him a chance to report his own observations in print. "Rephibia" contains notes and quotes from as many newspapers, and other journals as we are able to obtain that might be of interest to our readers. Book reports, zoo news and other regular departments are always included. Published 10 times yearly, the subscription rate is \$1.50 to persons out of the greater New York area. We recommend "Rephibia" not to the professional or semiprofessional herpetologist, but to his students and children so that they may keep up with current discoveries without laboring through long technical publications, as well as contributing their own findings. Special subscription to students, members of the ASIH and other organizations and institutions is \$1.00. Inquiries should be addressed to: Rephibia, 8525 Shore Road, Brooklyn 9, New York. Steve Grenard is Acting Editor.

#### University of Southern California

The Department of Biology at the University of Southern California is currently engaged in expanding its work in vertebrate biology. The program in herpetology is under the direction of Dr. Jay M. Savage and the following students are studying for advanced degrees in this area of research. Frederick W. Schuierer is working toward a Ph.D. with his dissertation based on studies of the biosystematics of toads of the *Bufo boreas* Group. Arnold G. Kluge is doing his M.A. thesis on the osteology and evolution of eublepharine geckos. Shelley R. Johnson is a master's candidate working on the life-history and behavior of chuckwalla. Allan A. Schoenherr, also a master's candidate, continues studies on California desert reptiles. Arden H. Brame, Jr., is currently in the U.S. Army but expects to return to his work on salamanders in the fall of 1958. Mrs. Priscilla H. Starrett, a doctoral candidate at the University of Michigan, under the guidance of Dr. Charles F. Walker, continues her research on frog morphology and larvae. She has joined the SC group following the appointment of her husband, Dr. Andrew Starrett, a mammalogist, to the faculty. Dr. Savage is primarily concerned with additional work on his revision of the family Xantusiidae, studies on the osteology of the Iguanidae and a report on the zoogeography of western amphibians and reptiles. Courses recently added

to the departmental offerings of particular interest to advanced students in herpetology include: Herpetology, Zoogeography, Principles of Systematics, Advanced Vertebrate Morphology and Evolutionary Osteology.

#### Carl L. Hubbs

AFTER participating (as vice-chairman) in the Colloquium on Nomenclature in London, and in the following 15th International Zoological Congress, Dr. HUBBS has traveled about Europe, with Mrs. HUBBS, Dr. FRANCES N. CLARK, and Mrs. MARION YOUNG. The trip included visits and some research at various museums, universities, and biological stations in England, Scotland, Belgium, Holland, Denmark, Norway, Sweden, Germany and France.

#### Göteborg Museum

THE Swedish ichthyologist, Dr. HJALMAR RENDAHL, has retired as professor in charge of the division of vertebrates in the Naturhistoriska Riksmuseet in Stockholm. Dr. ALF S. JOHNELS has been appointed to this position, after having served briefly as Dr. ORVAR NYBELIN's successor in the Naturhistoriska Museum of Göteborg. Dr. NYBELIN is carrying on as the scientific director of the Göteborg Museum, pending a new appointment. Dr. JOHNELS' current research deals with the anatomy and phylogeny of fishes, with particular reference to the sympathetic nervous system. Dr. NYBELIN has been working recently on deep-sea fishes, with special reference to the Brotulidae. Both he and Dr. RENDAHL plan to continue their ichthyological researches.

#### National Science Foundation

THE Division of Biological and Medical Sciences of the National Science Foundation announces that the next closing date for receipt of basic research proposals in the Life Sciences is January 15, 1959. Proposals received prior to that date will be reviewed at the Spring meetings of the Foundation's Advisory Panels and disposition will be made approximately four months following the closing date. Proposals received after the January 15, 1959, closing date will be reviewed following the Spring closing date of May 15, 1959.

Inquiries should be addressed to the National Science Foundation, Washington 25, D.C.

#### National Museum of Canada

THE National Museum of Canada appointed Mr. D. E. McALLISTER as their first curator of fishes. Mr. McALLISTER re-



ceived his M.A. from the Institute of Fisheries, University of British Columbia and spent one post graduate year at the University of Michigan. He is now in the process of building up a collection of fishes and hopes to do research on the marine fishes of Arctic North America.

**R**oger Revelle, Director of the University of California's Scripps Institution of Oceanography, has been given the additional responsibility of Director of the University's new Institute of Technology and Engineering.

The appointment was announced by PRESIDENT CLARK KERR following approval by the Regents of the University.

The Institute was established by the Regents in July to provide graduate instruction and research in mathematics, physics, chemistry, the earth and biological sciences and engineering. It will be located at La Jolla.

Revelle has been Director of the Scripps Institution since 1951.

#### SUMMARY OF 1958 MEETING

**T**HE thirty-eighth annual meeting of the American Society of Ichthyologists and Herpetologists was held on the campus of Indiana University, Bloomington, Indiana, August 24-28, 1958. The meeting was held in conjunction with the American Institute of Biological Sciences. The Local Committee consisted of SHERMAN A. MINTON, JR. and SHELBY D. GERKING.

#### EVENTS OF SUNDAY, AUGUST 24

The annual meeting of the Board of Governors of the Society convened at 7:00 PM with thirty-three governors and several guests in attendance.

With PRESIDENT EDWARD H. TAYLOR in the Chair, Secretary Conant read messages from the following absentee members of the Board: JOHN C. BRIGGS, FRED R. CAGLE, JAMES KEZER, LAURENCE M. KLAUBER, JOHN C. MARR, GEORGE S. MYERS, JOHN TEE-VAN, BOYD W. WALKER, and LOREN P. WOODS.

Messages were also received from Pakistan from SHERMAN A. MINTON, JR., and from Germany from ROBERT MERTENS, one of our Honorary Foreign Members.

The minutes of the 1957 meeting were approved as published in *Copeia*, 1957 (4): 317-327.

Ten persons were elected to the Board of Governors for the Class of 1963, as follows: WALTER AUFFENBERG, GORDON GUNTER, CARL GANS, RICHARD HIGHTON, GILES W. MEAD,

KENNETH L. NORRIS, GEORGE RABB, PHILIP W. SMITH, VLADIMIR WALTERS, and LOREN P. WOODS. RICHARD E. ETHERIDGE and ROBERT H. GIBBS were elected to fill vacancies in the class of 1961, and JAMES E. MOSIMANN was elected to fill a vacancy in the Class of 1959.

The death of MALCOLM A. SMITH, one of the Society's Honorary Foreign Members, was reported. J. C. BATTERSBY, of the British Museum (Natural History), was elected to fill the vacancy.

The death of ALVIN SEALE, a former active member of our Society, was also noted. It was the consensus to recommend to the Editor-in-Chief that an obituary note and a photograph of both the DOCTORS SMITH and SEALE be used in *Copeia*.

PRESIDENT TAYLOR announced that it was customary for the Society to contribute toward the publication of the Zoological Record. A motion was made, seconded, and carried to donate forty-five pounds, an increase of five pounds over last year.

SECRETARY CONANT strongly recommended that meeting places be selected for at least two years in advance. After considerable discussion the governors voted to accept the invitations from several institutions in San Diego and La Jolla, California, to meet in those communities during June, 1959. The Board also voted to accept the invitation of the Chicago Natural History Museum to meet in Chicago between March 1 and October 10, 1960. The selection of actual dates was left to the Executive Committee and the Local Committees.

DR. JOSEPH R. BAILEY suggested the possibility of a field meeting sometime during the near future at one or more of the biological stations along the North Carolina coast. This suggestion was greeted by such enthusiasm that DR. BAILEY was urged to investigate the matter at his earliest convenience.

In conjunction with plans for future meetings, the Secretary was instructed to communicate with the American Society of Mammalogists to determine whether it might be possible to meet at the same place as that Society about every third year.

None of the three Vice-Presidents was in attendance, but since written reports from each had been distributed to all the governors, the reports were not read in their entirety. DR. BOYD W. WALKER, Vice-President for Conservation, recommended that the Society pass a resolution condemning the anti-fire-ant campaign proposed by the U. S. Department of Agriculture. The Secretary read a resolution that had been prepared on this subject. It was recommended

that the meeting

DR. J. reported income mended scription as opera year sh preceding hand sh ment i *Copeia*; should campai DR. M. another would AIBS.

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that the resolution be acted upon at the business meeting to be held on Thursday, August 28.

DR. JOHN C. MARR, Vice-President for Finance, reported on ways and means of increasing future income for the Society. He specifically recommended that: (1) all income from dues, subscriptions, and sale of back numbers be regarded as operating income; (2) the budget for any given year should equal the operating income of the preceding year; (3) all other income or cash on hand should be invested to build up an investment income for the future enlargement of *Copeia*; and (4) sources of additional income should be sought, especially through an active campaign to increase membership and gifts. DR. M. GRAHAM NETTING pointed out that another way of saving money for the Society would be to discontinue full membership in AIBS.

DR. JAMES KEZER, Vice-President for Membership, reported on a campaign he had conducted to increase subscriptions to *Copeia*. This was done by urging members to solicit subscriptions from libraries in communities or institutions where *Copeia* was not currently being received. The Secretary reported that DR. KEZER's efforts were already proving a success.

DR. FRED R. CAGLE, Editor-in-Chief (who was traveling in Russia during the meetings), submitted a report in which he analyzed the contents of *Copeia* during the year 1957. He mentioned, among other things, that the time from receipt of manuscripts to their eventual acceptance and publication had decreased to slightly less than eight months. He urged persons submitting papers to *Copeia* to follow the style of our journal as outlined in "Suggestions for authors publishing in *Copeia*," *Copeia*, 1958 (1): 67-69.

DR. N. BAYARD GREEN, Publications Secretary, presented a report showing that the Society had cleared \$998.32 from sales of back numbers of *Copeia* and other publications through his office. In addition, \$11.25 worth of publications had been credited to him through the Secretary's office, thus making a total of \$1009.57 income from this source during 1957. DR. GREEN was given a round of applause for his long and excellent handling of his duties.

DR. COLEMAN J. GOIN, who retired as Treasurer at the beginning of the current year, presented his report for the calendar year of 1957, as follows:

#### Financial Report for Calendar Year 1957

##### CHECKING ACCOUNT

Balance on hand, Citizen's Bank of Gainesville, Jan. 1, 1957.....	\$6,575.84
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##### RECEIPTS

Memberships Received.....	6,649.60
Subscriptions Received.....	4,448.95
Back numbers of <i>Copeia</i> sold	
Publications Secretary (Huntington).....	983.66
Secretary, Gainesville and Philadelphia.....	15.00
	998.66
Check List Sold.....	3.25
Common Name Check Lists sold.....	99.41
Interest—Stoye Fund Bonds.....	65.10
Interest—Endowment Fund Bonds.....	185.40
Contributions	
Anonymous (Dunn Memorial Number).....	100.00
George P. Meade (Dunn Memorial Number).....	25.00
L. M. Klauber (Dunn Memorial Number).....	25.00
Roger Conant (Dunn Memorial Number).....	25.00
L. W. Reid (Dunn Memorial Number).....	25.00
C. M. Breder (Dunn Memorial Number).....	10.00
Harold Trapido (Dunn Memorial Number).....	10.00
L. M. Outten (Dunn Memorial Number).....	5.00
Karl Lagler (Dunn Memorial Number).....	5.00
Roger Conant (Schmidt Memorial Number).....	25.00
Boyd W. Walker (Schmidt Memorial Number).....	10.00
Carl L. Hubbs (Western Division Prizes).....	40.00
L. M. Klauber (Western Division Prizes).....	40.00
Miscellaneous contributions.....	6.00
	351.00
Charges for Mailing List.....	10.00
Charges for plate in <i>Copeia</i> .....	60.00
Sale of typewriter.....	34.20
Total.....	\$19,481.41

##### EXPENDITURES AND DISBURSEMENTS

Cost of publication of <i>Copeia</i>	
1956, no. 4.....	\$1,870.03
1957, no. 1.....	1,690.20
1957, no. 2.....	2,324.21
1957, no. 3.....	2,105.21
	7,989.65
Printing.....	610.46
Stenographic Services, Gainesville.....	150.00
Social Security.....	2.50
Postage	
Secretaries.....	267.00
Editors.....	250.00
	517.00
Phone calls	
Editors.....	32.00
Acting President.....	13.00
	45.00
Transportation of files to Philadelphia.....	105.42
Contributions	
Remittance of 40 pounds to Zoological Society to assist in publication of "Zoological Record".....	113.60
Treasurer's bond, 1957.....	5.00
Travel, Secretary to New Orleans.....	140.00
Bank Charges.....	22.82
Dues, A. I. B. S.....	836.00

## Student prizes

Stoye	
Ralph W. Axtell (1st prize, Herpetology).....	\$25.00
John M. Legler (2nd prize, Herpetology).....	15.00
James A. MacMahon (special prize, Herp.).....	10.00
Victor G. Springer (1st prize, Ich.).....	25.00
Richard Rosenblatt (2nd prize, Ich.).....	15.00
Western Division	
Velma J. Vance (1st prize, Herp.).....	25.00
James P. Mackey (2nd prize, Herp.).....	15.00
Jay C. Quast (1st prize, Ich.).....	25.00
Warren C. Freihofer (2nd prize, Ich.).....	7.50
George W. Barlow (2nd prize, Ich.).....	7.50
	170.00
Total Expenditure.....	\$10,707.45
Balance on hand, December 31, 1957	
Citizen's Bank, Gainesville.....	1,397.10
Central-Penn National Bank, Phila.	7,466.86
	8,773.96
Total.....	\$19,481.41

## ENDOWMENT FUND

Balance on hand, First Federal Savings and Loan Association, January 1, 1957.....	
	\$1,999.71
Received from Life Members.....	800.00
Interest.....	79.26
Total.....	2,878.97
Balance on hand, December 31, 1957	
First Federal Savings and Loan, Gainesville.....	2,428.64
Central-Penn National Bank, Philadelphia.....	450.33
	2,878.97

## REVOLVING RESEARCH FUND

Balance on hand, Florida Bank of Gainesville, January 1, 1957.....	
	220.25
Received from J. M. Savage.....	100.00
Total.....	320.25
Grant to Alfred W. Ebeling.....	80.00
Balance on hand, Florida Bank of Gainesville, December 31, 1957.....	\$ 240.25

In the absence of its members, the report of the Auditing Committee was read by the Secretary as follows: "The undersigned have reviewed the records of DR. COLEMAN J. GOIN kept in connection with his service as Treasurer of the American Society of Ichthyologists and Herpetologists. To the best of our knowledge and belief, the records are in good order and the funds of the Society have been carefully and faithfully kept." (Signed: JOHN D. KILBY and WALTER AUFFENBERG.)

The Secretary presented his report stating that currently we are carrying 1091 members and 441 subscribers on our rolls. There are members in all states, including Alaska. Eighty-three new members and forty-seven new subscriptions were received between August 14, 1957, and August 13, 1958. Receipts during this "fiscal year" from all sources are running slightly ahead of 1957. The change from monotype to linotype and the use of coated paper have resulted in a decrease of \$1.30 per page in the cost of publishing *Copeia*.

DR. ARNOLD B. GROBMAN, a member of the Governing Board of the American Institute of Biological Sciences, reported on a meeting of that Board which he attended at Madison, Wisconsin, on May 9 and 10, 1958. He succinctly outlined AIBS activities, pointing out the many things it has been able to do for its members and member societies.

DR. EARL S. HERALD reported briefly upon activities of the Western Division of ASIH, and the DOCTORS JOSEPH R. BAILEY and WILLIAM J. RIEMER reported on activities of the South-eastern Division.

At the request of PRESIDENT TAYLOR, DR. GROBMAN, Acting Chairman, reported for the Nominating Committee. In preparing its slate the committee noted that there are so many persons worthy of serving the Society as president that the years will run out long before the list of candidates is exhausted.

To remedy this situation the committee recommended that the two-year term for president be abolished and that, instead, a president-elect should be designated every year. The president-elect would succeed to the presidency, and he would have had a chance to become thoroughly familiar with the duties and problems of that office in advance. To implement this change it would be necessary to amend the constitution and by-laws as follows: In Article IV, Section 1, the statement concerning "a president" should be deleted and replaced by the following: "A president who shall automatically assume the duties of this office for a one-year term immediately following his term as president-elect. The president-elect shall serve a one-year term; the office shall alternate annually between an ichthyologist and a herpetologist; the president-elect shall be ineligible to succeed himself until two years shall have elapsed from the end of his term as president."

To aid with indocrinating the president-elect it was recommended that Article II, Section 2, of the by-laws be amended by adding the following sentence: "The president and president-elect shall be ex officio members of all com-

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mittees." The Board of Governors voted by more than the necessary two-thirds majority to make these amendments to the constitution and by-laws.

DR. GROBMAN reviewed the slate of names that his committee intended to place in nomination before the membership of the Society at the business meeting held on Thursday, August 28.

DR. HOBART M. SMITH, Chairman of the Committee on Zoological Nomenclature, stated that his committee had no report to make.

DR. JAMES A. OLIVER, Chairman of the Committee on Traffic in Venomous Snakes, reported that the postal authorities remained adamant in their attitude barring live harmless snakes from the mails. He stated that a bill introduced in Congress to prohibit the importation of "cobra snakes" and eggs had died in committee.

DR. ROBERT F. INGER, Chairman of the Committee on the KARL P. SCHMIDT Memorial Number of *Copeia*, recommended on behalf of his committee that manuscripts for this number be on an invitational, rather than on a "first come, first served" basis. The committee suggested the names of several persons in this country and abroad who had been close associates of Karl Schmidt and who might be invited to participate.

DR. JAMES A. OLIVER, Chairman, reported for the Committee for Investigation of *Copeia* Costs. His committee's report was voluminous and reflected the large amount of research and effort expended upon the problem. In essence, it indicated that Waverly Press, the current publisher of our journal, is giving us a competitive price. The Allen Press, of Lawrence, Kansas, offered to better the Waverly price by a small amount. Investigation among other journals that had been transferred to the Allen Press indicated that the move had thrown heavy additional burdens upon the editors. The University of Texas Press possibly could do the work at a considerable saving, but in the absence of cost figures no comparison could be made. After much discussion it was decided to remain with Waverly Press during 1959, but the committee was requested to look further into the possibility of using the facilities of the University of Texas Press. It was recommended that the Editor-in-Chief be added to the committee.

The Secretary was authorized to lend the name of our Society as a co-sponsor of the Linnaean Bicentennial Celebration to be held in Washington in December.

DR. GROBMAN reminded the Governors that in 1963 *Copeia* will be fifty years of age. He recommended that a committee be appointed to prepare for this anniversary.

DR. OLIVER announced that efforts were being made to establish a permanent biological station in the Galápagos Islands in conjunction with the Darwin Centennial. Institutions able to cooperate financially or in other ways are being asked for their help.

The meeting adjourned at 10:15 PM.

#### EVENTS OF MONDAY, AUGUST 25

PRESIDENT TAYLOR presided at the first joint session of the Ichthyologists and Herpetologists at which 178 persons were in attendance. In the absence of DR. MINTON, Chairman of the Local Committee, DR. SHELBY D. GERKING welcomed the members to the Indiana University Campus. The following papers were presented:

A Review of Homing in Fishes. Shelby D. Gerking, Indiana University.

A Preliminary Report on the Cause of Ciguatera (poisoning from tropical marine fish). John E. Randall, Marine Laboratory, University of Miami.

Glacial Relicts in the West Indies and Gulf of Mexico. Vladimir Walters, American Museum of Natural History, New York.

Habits of the Eastern Diamondback Rattlesnake, *Crotalus adamanteus*. Wilfred T. Neill and Ross Allen, Ross Allen Reptile Institute, Silver Springs, Florida.

Fire Ants, Heptachlor, and Fish Kill. Kirk Strawn, Jack Boudreaux and Gerald Callas, Lamar State College of Technology, Beaumont, Texas.

A Zoogeographical Analysis of the Herpetofauna of New Mexico. Frederick R. Gehlbach, Cornell University.

Immediately after the morning meeting the members and their spouses assembled on the steps of the Education Building for the annual group photograph. During the afternoon DR. ALBERT P. BLAIR presided at the herpetological session. The following papers were presented:

Genetic Incompatibility in "Call Races" of *Hyla versicolor*. Le Conte. Clifford Johnson, University of Texas.

Hybridization Tests of U. S. Toads. W. Frank Blair, University of Texas.

Call as an Isolating Mechanism in some Australian Anura. Murray J. Littlejohn, University of Texas.

The Mechanism of Call Production in Certain Anuran Amphibians. Wayne H. McAllister, University of Texas.

Movements and Behavior of *Bufo fowleri* in Residential Areas. Denzel E. Ferguson, Mississippi State College.

Further Observations on Hybridization between *Hyla crucifer* and *Pseudacris nigrita*. John W. Crenshaw, Jr., Antioch College, Yellow Springs, Ohio.

Concurrently DR. SHELBY D. GERKING presided over the ichthyological session where the following papers were heard:

Growth in the Cavespring Fish, *Chologaster agassizi* Putnam. William M. Clay and William W. Weber, University of Louisville.

Effects of Temperature on the Hatching Time of some Southwestern Darters. Clark Hubbs, University of Texas.

Evidence for Natural Hybridization in the American Gobies of the Genus *Gobiomorus*. Robert R. Miller, University of Michigan.

Breeding Behavior of the Egyptian Mouthbreeder. (Movie) Hymen Marx and Luis De La Torre, Chicago Natural History Museum.

Ecological Factors in the Reproductive Physiology of Marsh Killifish, *Fundulus confluentus*. Robert W. Harrington, Jr., Entomological Research Center, Florida State Board of Health.

Strigeid Trematodes—the Cause of Death of Yearling Black Bass in Hatcheries. Richard J. Baldauf, A. and M. College of Texas.

Some Aspects of the Behavior of the Blennioid Fish, *Chaenopsis ocellata* (Poey). C. Richard Robins, Craig Phillips and Fanny Phillips, Marine Laboratory, University of Miami. Evolutionary Patterns in Boreal Blennioid Fishes with a Proposed Classification. Norman J. Wilimovsky, U. S. Fish and Wildlife Service.

#### EVENTS OF TUESDAY, AUGUST 26

Those members who were able to arise very early in the morning and who did not have other (AIBS) sessions to attend participated in a field trip to the Spring Mill State Park, about 40 miles south of Bloomington. There they visited Twin Caves and caught and examined blind fish. The parties in individual cars then divided, some returning to Bloomington, others visiting the rugged scenic country of southern Indiana. During the evening the annual Symposium on Aquaria was held with Dr. EARL S. HERALD acting as co-ordinator. The program presented at this meeting follows:

Longevity Among Aquarium Fishes. Sam Hinton, Scripps Institution of Oceanography.

Comments on Keeping the Pilot (Blackfish) Whale in Captivity. F. G. Wood, Jr., Marineland, Florida.

Relative Performance of Different Depths of Filtrant in Sand Filters. William Kelley, Cleveland Aquarium.

Principles and Practices of Water Management in Public Aquariums. James W. Atz, New York Aquarium, N. Y. Zoological Society.

Shedd Aquarium's New Railroad Collecting Car, The Nautilus. William Braker, Shedd Aquarium, Chicago, Illinois.

Cinematographic Review of the External Features of Various U. S. Aquariums. Earl S. Herald, Steinhart Aquarium, California Academy of Sciences.

Sharks and New Field Collecting Techniques. Captain William Gray, Seaquarium, Miami, Florida.

Deterioration of Cement Aquariums Due to Salt Water Corrosion. William Braker, Shedd Aquarium, Chicago, Illinois. New Exhibition Methods at the Vancouver Aquarium. Murray Newman, Vancouver Public Aquarium, Stanley Park, Vancouver, B. C.

The First Year of Operation of the New York Aquarium (color film review). James W. Atz, New York Aquarium, N. Y. Zoological Society.

#### EVENTS OF WEDNESDAY, AUGUST 27

Divided meetings began at 9:30 AM. DR. ROYAL D. SUTTKUS presided over the ichthyological session where the following papers were heard:

Variation in the Darter, *Etheostoma fusiformis*. Bruce B. Collette, Cornell University.

Host Specificity Among the Diskfishes and some Related Problems. Ernest A. Lachner, Smithsonian Institution, Washington, D. C.

Systematic Study of the Freshwater Fish Genus *Gila* in Mexico. Teruya Uyeno, University of Michigan.

On the Two Species of Lancet Fishes (*Alepisaurus*) in the Western Atlantic. Robert H. Gibbs, Boston University.

A New Catostomid Fish from the Green River Basin, Kentucky and Tennessee, with Comments on the Status of *Thoburnia*. Reeve M. Bailey, University of Michigan.

The Swim Bladder of the Serrasalminae. Edward M. Nelson, Strich School of Medicine, Loyola University, Chicago.

Spawning in the Glassy Darter with Comments on the Evolution of Behavior in Darters. Howard E. Winn, University of Maryland.

Methods and Preliminary Results of Population Discrimination Studies on Alaska Herrieig. Norman J. Wilimovsky, U. S. Fish and Wildlife Service.

With MR. CLIFFORD H. POPE presiding the herpetologists heard the following papers:

The Anterior Cranial Elements of *Gyrinophilus* and *Pseudorion*. Arnold B. Grobman, Florida State Museum.

The Status of the Cope Salamander Genera, *Schaperpeton* and *Hemitryps* (presented by Dr. C. J. Goin). Walter Auffenberg and Coleman J. Goin, Museum of Comparative Zoology and University of Florida.

The Caudal Vertebrae of Lizards. Richard Etheridge, University of Michigan.

Home Range and Population Behavior of the Eastern Fence Lizard, *Sceloporus undulatus hyacinthinus*. J. P. Kennedy, University of Texas.

Geographic Variation in the Life History of *Plethodon glutinosus*. Richard Highton, University of Maryland.

After lunch there again were separate sessions. DR. REEVE M. BAILEY presided over the ichthyologists who heard the following papers:

Formation of an Anal Spine from a Soft Ray in Serranid and Percid Fishes. Romeo Mansueti, Chesapeake Biological Laboratory, Solomons, Maryland.

Biology of the Dolphins, *Coryphaena hippurus* and *C. equisalis*. Robert H. Gibbs, Boston University.

A Contribution to the Life History of the Squirrelfish, *Holocentrus vexillarius* Poey. Thomas W. McKenney, University of Miami.

Preliminary Notes on the Systematics and Distribution of the Short Bigeye, *Pseudopriacanthus aetus* (Gill). David K. Caldwell, U. S. Fish and Wildlife Service.

The Experimental Production of Chordomas in Fish. Barnet M. Levy, University of Texas Dental School, Houston.

Distribution of Young Jack Crevalles (*Caranx* spp.) off the Southeastern United States. Frederick H. Berry, U. S. Fish and Wildlife Service.

Species Replacement in Two Oklahoma Reservoirs. Carl D. Riggs, University of Oklahoma.

In the meantime the herpetologists were called together by ARNOLD B. GROBMAN, presiding, to hear the following papers:

The Pleistocene Herpetofauna of Saber-tooth Cave, Citrus Co., Florida. J. Alan Holman, University of Florida.

The Morphological Basis of Caecilian Taxonomy. Harold W. Kerster, University of Chicago.

Interrelationships of the Costa Rican Centrolenidae. Priscilla Starrett, University of Southern California.

Variation in the Snake, *Rachidelus brazili* Joseph R. Bailey, Duke University.

The Use of Weight in Estimating Size and Growth in Reptiles. James E. Mosimann, University of Montreal, Canada.

Why is *Rhineura* Specialized? Carl Gans, University of Buffalo.

After the two joint meetings had been completed, all members and many guests assembled together to see an extraordinarily fine collection of color transparencies of western amphibians and reptiles that were taken and shown by NATHAN W. COHEN, Modesto Junior College, Modesto, California.

The annual banquet was held in the Marine Room of the Indiana Union, and so many persons attended that for a short time the banquet threatened to overflow into the adjacent lobby. DR. JAMES A. PETERS acted as toastmaster. PRESIDENT TAYLOR spoke briefly with his customary wit on his plans for writing future herpetologies. The Fred Stoye Prize Committee, consisting of DR. M. GRAHAM NETTING, DR. JAMES A. PETERS, and DR. ERNEST A. LACHNER gave its report. The best student papers at the meeting were adjudged to be as follows:

In herpetology:

First Prize, Richard E. Etheridge, University of Michigan, \$25.

Second Prize, Wayne H. McAlister, University of Texas, \$15.

In ichthyology:

First Prize, Bruce B. Collette, Cornell University, \$25.

DR. COLEMAN J. GOIN, the speaker for the evening, presented a scholarly address entitled "The Evolution of Amphibian Life Histories."

#### EVENTS OF THURSDAY, AUGUST 28

Members assembled in a joint meeting with Dr. William M. Clay presiding. The following papers were presented:

Aspects of the Life History of the Great Barracuda, *Sphyraena barracuda* (Walbaum). Donald P. DeSylva, Bay-side Marine Laboratory, University of Delaware.

The Present Search for a Shark Repellent. Perry W. Gilbert, Cornell University.

Hemopathic Snakebite: Influence of Site of Bite upon Symptoms. Hobart M. Smith, University of Illinois. (Read by Joe A. Tihen.)

A Comparison of some Bahama and Florida Shore Fish Species. A Preliminary Report. James E. Böhlke, Academy of Natural Sciences of Philadelphia.

A Summary of Albinism in North American Amphibians and Reptiles. Max Hensley, Michigan State University.

Preliminary Remarks on the Life History of the Shielded Darter, *Percina peltata*, in New York. John G. New, State University Teachers College, Oneonta, New York.

The Ecology of Fishes in the Savannah River Plant Area, South Carolina. Harry W. Freeman, University of South Carolina.

At 1:30 PM the annual business meeting of ASIH was held with PRESIDENT TAYLOR in the Chair. DR. TAYLOR called upon the Secretary who reported briefly on what had transpired at the Board of Governors meeting held Sunday, August 24.

DR. ROBERT F. INGER, a member of the Resolutions Committee, presented the resolution condemning the fire-ant control program and this was passed unanimously. The Secretary was instructed, however, to communicate with certain experts on the uses of heptachlor and dieldrin, the chief poisons intended to be used. The Secretary was authorized to alter the factual content of the resolution as a result of a conference with said experts, and then to forward the resolution to the Secretary of Agriculture and to the Chairman of the House and Senate Appropriations Committees, and also to any other persons who might be interested.

DR. REEVE M. BAILEY reported for the Committee on Common Names for Fishes. He announced that after lengthy deliberations his committee had revised the list of common names and that it would be published sometime soon under the auspices of the American Fisheries Society.

DR. GROBMAN reported for the Nominating Committee outlining the plan to change the term of president from two years to a single year and to establish the office of president-elect (as outlined above in the report of the Board of Governors meeting). The necessary changes in the constitution and by-laws were passed unanimously.

DR. GROBMAN then presented the recommendations of the Nominating Committee, and in due course the following persons were elected:

President: Reeve M. Bailey

President-elect: Norman E. Hartweg

Vice-President for Conservation: M. Graham

Netting

Vice-President for Finance: John C. Briggs

Vice-President for Membership: James Kezer

Secretary: Roger Conant

Treasurer: James E. Böhlke

Publications Secretary: N. Bayard Green

Editor-in-Chief: Ernest A. Lachner

Editorial Board

Book Review Editor: Ernest E. Williams

Index Editor: David L. Jameson

Ichthyological Board:

Reeve M. Bailey

James E. Böhlke



Robert W. Harrington, Jr.

Clark F. Hubbs

Giles W. Mead

Robert R. Miller

Edward M. Nelson

Edward C. Raney

Lionel A. Walford

Loren P. Woods

#### Herpetological Board:

Charles M. Bogert

Edwin H. Colbert

Henry S. Fitch

Wade Fox, Jr.

Howard K. Gloyd

Laurence M. Klauber

James A. Oliver

Clifford H. Pope

William H. Stickel

Joseph A. Tihen

DR. GROBMAN reported on the benefits that our Society derives from being a full member society of AIBS. He stated that records of research in progress were being kept by Bio-Sciences Information, 113 DuPont Circle Building, Washington 6, D. C., and he suggested that information about the research of ASIH members and their students be sent to that agency.

DR. TAYLOR appointed the following committee to investigate the translation of Russian biological literature: DONALD P. DE SYLVA, Chairman, FRED R. CAGLE, CARL GANS, and ERNEST A. LACHNER. DR. SHELBY D. GERKING suggested asking the committee also to investigate the possibility of translating biological literature from Chinese and Japanese to English. Since there were no persons at the meeting conversant with either of these two oriental languages no additions were made to the committee.

PRESIDENT TAYLOR appointed the following persons to serve as the Society's Nominating Committee for 1959: M. GRAHAM NETTING, Chairman, EARL S. HERALD, ERNEST A. LACHNER, ROBERT R. MILLER, and JAY M. SAVAGE.

PRESIDENT TAYLOR called for the report of the Resolutions Committee consisting of DR. EDWARD C. RANEY, Chairman, DR. ROBERT F. INGER, and DR. ARNOLD B. GROBMAN. In the absence of the Chairman, DR. INGER read a resolution as follows:

"Whereas the 38th Annual Meeting of the American Society of Ichthyologists and Herpetologists held at the University of Indiana has been concluded, and, whereas the meeting has been one of the most successful in the history of the Society,

"Be it, therefore, resolved that the American Society of Ichthyologists and Herpetologists extends its thanks and gratitude to the members

of the local committee, the DOCTORS SHELBY D. GERKING and SHERMAN A. MINTON, JR., and to those who planned and led the field trips, the DOCTORS JAMES C. LIST, PHILIP W. SMITH, and H. B. BECHTEL, and MR. GERALD GUNNING."

Consideration of the sixth edition of the check list of North American amphibians and reptiles, compiled by the late KARL P. SCHMIDT and published in 1953, followed. Considerably less than half of the copies of the check list have been sold. DR. JAMES A. PETERS recommended that the copies be placed on a remainder list and be sold for whatever sum will enable the Society to liquidate its investment. After considerable further discussion it was the consensus of the meeting to ask the Society's Executive Committee and its Publications Secretary to study the matter and make recommendations.

There being no further business the meeting was adjourned at 3:05 PM.

#### BOARD OF GOVERNORS

1959

Class of 1959: R. H. Bachus, A. P. Blair, H. G. Dowling, H. W. Freeman, H. K. Gloyd, J. D. Kilby, K. F. Lagler, J. E. Mosimann, J. M. Savage, R. W. Yerger.

Class of 1960: F. N. Clark, G. P. Cooper, N. E. Hartweg, J. Kezer, G. A. Moore, R. C. Snyder, M. Storey, B. W. Walker, C. F. Walker, N. Wilimovsky.

Class of 1961: J. R. Bailey, W. F. Blair, J. C. Briggs, R. E. Etheridge, H. S. Fitch, R. H. Gibbs, E. S. Herald, W. J. Riemer, M. Trautman, V. Vladikov.

Class of 1962: E. Clark, W. M. Clay, C. J. Goin, A. B. Grobman, R. W. Harrington, Jr., C. F. Hubbs, R. F. Inger, N. D. Richmond, C. R. Robins, R. G. Zweifel.

Class of 1963: W. Auffenberg, G. Gunter, C. Gans, R. Highton, G. W. Mead, K. L. Norris, G. Rabb, P. W. Smith, V. Walters, L. P. Woods.

#### Past Presidents:

C. M. Bogert, C. M. Breder, J. R. Dymond, H. W. Fowler, H. T. Gaige, W. K. Gregory, C. L. Hubbs, L. M. Klauber, G. S. Myers, M. G. Netting, J. T. Nichols, C. H. Pope, E. C. Raney, A. G. Ruthven, E. H. Taylor.

#### Ex Officio Members

##### National Officers:

R. M. Bailey, J. E. Böhlke, E. H. Colbert, R. Conant, W. Fox, Jr., N. B. Green, D. L. Jameson, E. A. Lachner, R. R. Miller, E. M. Nelson, J. A. Oliver, W. H. Stickel, J. A. Tihen, L. A. Walford, E. E. Williams.

##### Divisional Officers:

L. Dempster, E. E. Brown.

albomac  
atopod  
Bathop  
darwin  
Dikello  
fleming  
Gobion  
Hypog  
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